PLATE I

Florence Nightingale
Established the first training-school for nurses, 1860.

MODERN METHODS

IN

NURSING

BY

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THIRD EDITION, THOROUGHLY REVISED

"The knowledge that will hold good in working — cleave thou to that."

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PREFACE TO THE THIRD EDITION

In this edition the *Introduction* found in the previous editions has been omitted. In it were discussed various methods of training, with the object of guiding a prospective student in her selection of a training-school among schools of very varying standards. At the present date the registration of nurses is an accomplished fact in practically every state, with the result that curriculæ and methods of training have become standardized, and all schools whose graduates are eligible for registration must comply with the requirements, in educational facilities and equipment, of the board of examiners for registration of nurses in their state. Such schools are known as "accredited schools." In graduating from any accredited school a nurse may be sure she has received a training that will prepare her to fulfil the requirements for registration in that state and to fit her to practice her profession. Particulars of the requirements for graduation and the qualifications required of a pupil nurse may be had on application to the secretary of the state board of examiners for the registration of nurses in each state. The questions, therefore, discussed in the former *Introduction* have ceased to be pertinent.

The section on Bacteriology has been revised and brought up to date by Miss Elizabeth M. Yagle, assistant to Dr. John A. Kolmer (Professor of Pathology and Bacteriology and Instructor in Bacteriology in the Graduate School of Medicine of the University of Pennsylvania). The principal addition to this section is the description and laboratory methods of identification of the more common pathogenic bacteria.

My thanks are due to Miss Yagle for her thorough and painstaking work.

My cordial thanks are also due to the nursing staff of the Massachusetts General Hospital and the Peter Bent Brigham Hospital, Boston; and of the Pennsylvania University Hospital and the Polyclinic Hospital, Philadelphia, for courteous help in various departments; to Dr. David Riesman, of Philadelphia, to whom I am indebted for advice on the section on "Diet in Disease," and to Miss Roberta M. West, Secretary to the Pennsylvania State Board of Examiners for the Registration of Nurses, for helpful discussion and information on the subject of curriculæ at the present day.

The chief contribution in practical nursing from the field surgery of the late war is, probably, the Carrel-Dakin method in the treatment of infected wounds. As this treatment is in general use in civil practice at the present day a description of the method is given in detail. The technic followed is that described in "Technic of the Carrel Method," by I. Dumas and Madame Carrel.

GEORGIANA J. SANDERS.

BRYN MAWR, PA.,
September, 1922.

PREFACE

In preparing a text-book that shall fit the curriculum required by a modern training-school, one has to face the drawback that some of the subjects which must be presented can be but very superficially appreciated by the writer. Properly speaking, such subjects as *bacteriology*, or *materia medica*, presented in however elementary a form, should be treated by those whose special study of the subjects qualifies them to speak with authority, a vantage ground which we as nurses are, obviously, far from claiming. The same is true of such matters as descriptions of symptoms and suggestions of remedies.

At the same time, those of us who have been for many years engaged in adapting such knowledge to the requirements of nursing, realize that it is often as important to have an interpreter as to have exact scientific information on these subjects. As such an interpretation the chapters on *elementary bacteriology* and *theories of immunity* are specially presented, leading as they do to the principles governing all our modern methods of nursing, and determining in particular all the details of surgical technic.

In writing the chapters I am indebted to many excellent lectures given in one or other training-school with which I have been connected, while for the practical and technical details involved I have gone as carefully as I could into those adopted by the leading hospitals in America, as well as those with which my own work has made me familiar, especially the Polyclinic Hospital, Philadelphia, and the Massachusetts General Hospital, Boston. On this point my thanks are specially due to the Johns Hopkins Hospital, Baltimore, the Pennsylvania Hospital, Philadelphia, and the Philadelphia Hospital. Where I have used a text-book I have, for the sake of simplicity, kept to the one with which I was most familiar in teaching, H. U. Williams' *Manual of Bacteriology*.

In the chapters on *food* and *food values* I have, for the same reason, used chiefly Miss Farmer's well-known book on invalid cookery. The chapter on *dieting* is compiled chiefly from the dietaries in use in various hospitals, especially the Polyclinic Hospital, Philadelphia, and the Massachusetts General Hospital, Boston.

Other text-books that have been used are Dock's *Materia Medica for Nurses*, the various text-books on nursing, and A. A. Stevens' *Manual of the Practice of Medicine*. A great deal of matter used has, however, been so long in my own note-books that, gathered originally merely for practical purposes, the source has been lost sight of, and I have made use of it not without some misgiving that, in so doing, I may prove myself an unwilling and unconscious plagiarist.

My thanks are also due to members of the nursing staff of the Massachusetts General Hospital, the Children's Hospital, Boston, and the Johns Hopkins Hospital for the charts reproduced; and to the authorities of the Polyclinic Hospital, Philadelphia, for permission to make many of the illustrations in their wards.

Georgiana J. Sanders.

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MODERN METHODS IN NURSING

CHAPTER I

PRACTICAL METHODS

Beds and Bed-making—A Medical Bed—A Surgical Bed—To Turn a Sheet—To Turn a Mattress—To Give a Fresh Mattress—Bed-bath—To Change the Shirt—Care of the Mouth—Care of the Back—Bed-sores—A Water-bed—To Give a Bed-pan—Care of the Hair—Treatment for Pediculi—Lifting—To Arrange a Patient Upright in Bed.

THE following lessons are specially designed to be taught to the pupils in classes: first, where practical, in the demonstration or class-room, and, afterward, practised under trained supervision at the patient's bedside.

From the beginning the pupil should be trained to use her power of intelligent observation, probably her most valuable practical quality as a nurse, and commonly latent at the beginning of her training. For example, in the simple matter of bed-making the pupil should be directed to notice the kind of bedstead used, the material of which the mattress is made, the quality of the bed-clothes, and the chief reasons for such selection pointed out. When each piece of work is finished, she should be taught to look at it and decide for herself it is perfectly finished or in what way defective. The habit of mind so formed is a solid gain.

BEDS AND BED-MAKING

The essential, indispensable part of the equipment of a sick-room or ward is the bed. It must be comfortable for the patient, practical to clean or disinfect, and convenient to handle.

The bed accepted as most suitable for nursing the sick is a single bed, made of enameled iron, with a wire spring mattress, and specially constructed to be easily taken apart and put together; the advantages are that they are light to move, easy to clean and disinfect, and do not harbor

dirt or insects, as did the older wooden bedsteads. A height of from 24 to 27 inches from the ground to the wire mattress is an immense help to either doctor or nurse in carrying out the offices and treatment required, and not generally objected to by the patient. The bedstead is usually 6 feet 4 inches long by 3 feet wide.

Wooden bedsteads, although not unknown in hospital work, are not infrequently met with in the homes of private patients. After any case of illness such a bedstead should be taken apart and subjected to thorough cleansing and disinfection (see *Disinfectants*), and, when practical, set in the sun, out-of-doors, for some hours. If animal life is discovered, the fumes of sulphur will kill the animals better than any other disinfectant, but nothing has yet been found to destroy the eggs. A wooden bedstead that is really infested with bed-bugs cannot be saved, and, when practical, should be burned.

Mattresses.—Mattresses are made of hair, cotton, wool, or wool and hair material, feathers, fiber, or straw, and usually covered with stout linen ticking. Cotton ticking may be used, but is neither so cool nor so durable. Straw can never be described as a comfortable bed, but has an advantage that, being inexpensive, it can be destroyed and renewed with each case, the covering, ticking, being washed as regularly as the bed-clothes. For this reason its use is sometimes advocated in epidemics of serious infections, such as small-pox. In the form of a palliass, a stiff mattress of closely packed straw, it is frequently used under a top mattress when it is required, as in fracture of a thigh, to use a mattress that will not sag.

The mattress of palm fiber, or of palm fiber mixed with hair, is less expensive than that altogether of hair, and if well made, is not uncomfortable and wears well.

The cotton mattress is also comfortable until beginning to wear, when it gets lumpy. Its disadvantages are that it is hotter than hair, considerably heavier, and absorbs and retains any discharges which may soak through the ticking. Being less expensive than hair, it is frequently used in dormitories, where its disadvantages are not of practical importance.

The feather mattress is not practical in the sick room on account of its heat, its tendency to form into hollows and lumps, and from the fact that it is very difficult and often impossible to make it comfortable with the patient in bed. It is never seen in a hospital. Persons, however, who are used to a feather mattress find anything else chilly and hard, and it requires much tact and judgment to introduce a more practical and hygienic form of mattress. In old people it may frequently be an ill it is wise to make the best of. In such a case half the mattress can be shaken up at a time, and the patient rolled on to the prepared half while the other is shaken.

A well-made mattress of wool and hair mixed is the most comfortable form of mattress, but, in hospital work, is considered less sanitary than one entirely of hair.

The mattress stuffed with horsehair is comfortable, hygienic, and cleanly, and the one in ordinary hospital and domestic use. That for hospital use is made slightly smaller than the spring mattress, as from frequent pressing it spreads somewhat, is usually four inches thick, and weighs from 20 to 26 pounds, 22 pounds being a usual average. It is lighter and does not soil so readily as the other varieties, horsehair being non-absorbent.

All mattresses should be protected by a washable cover, which may be made inexpensively of stout, unbleached muslin, and, well shrunken before making, fits the mattress as a pillow-cover does a pillow. By this means the life of a mattress will be materially prolonged.

In some hospitals, generally those devoted to maternity cases, the mattress is dispensed with altogether. Instead of the wire mattress or slats, a heavy piece of sack-cloth, canvas, or ticking is laced with cord to the four sides of the bed-frame. On this is laid a thick blanket covered by a rubber sheet and the usual bed-clothes. It is claimed that it is comfortable, cool in summer, economic, and certainly hygienic, as every part is washed after each case.

Pillows.—Pillows are made of hair, feathers, or down, the hair being useful to support limbs or retain the patient in a fixed position: they may also be used under a feather pillow for the head. Down is generally considered too expensive for hospital use unless for small pillows for the

head and for infants. The pillow in common use is the feather pillow, in size usually 30 inches by 20 inches. Pillows should be covered with linen ticking and not with cotton, as linen is perceptibly cooler to lie upon. Besides the pillow for the head, every ward should possess a number of small pillows, both of hair and of feathers, of varying sizes, from 8 inches square upward, to be used for special support.

Where necessary, the mattress or pillows are protected by rubber sheeting. These should be dispensed with, however, as soon as possible; not only are they uncomfortably heating, but they favor a tendency to bed-sores. In the interests of cleanliness and economy, however, their use is frequently unavoidable, and care should be taken to see that they are in a proper condition to fulfil their purpose. (See *Ward Management*, Chap. XXIV.) Pin-pricks and cracks from careless folding make a rubber as useless as a bucket with a hole in it.

Bed-clothes.—The bed-clothes needed in the sick-room are the same as those required in health, with the addition of the *draw-sheet*. This is a narrow sheet, either single or double, folded across the bed under the patient's hips, where naturally the greatest pressure of his weight is felt. Its object is, by drawing it to one side or another, to enable the sick person to have a cool and smooth spot given him to lie on without remaking the whole bed. It is made a yard longer than the width of the bed, and tucked with the larger portion under one side of the mattress, in order that it can be drawn at intervals to the other side. For hospital purposes a good cotton drill a yard wide is very practical. It is firm enough not to get easily into wrinkles, and takes, in mangling, a smooth polish agreeable to rest upon. Old sheets may be used, but are so soft as to wrinkle quickly. The habit of using half-soiled sheets as draw-sheets is not a good one. The sheets are of finer material than the draw-sheets and get unduly worn, besides frequently being stained in a way that makes them unsightly, and unfit for their own use.

Draw-sheets are also of use in protecting parts of the bed in danger of soiling, as from hemorrhage, surgical dressings, discharging wounds, and so forth, their advantage

again being that they can be changed with little disturbance to the patient.

Where necessary for the further protection of the bed, a small *rubber sheet*, at least four inches narrower than the draw-sheet, can be placed below the draw-sheet above the under sheet. It must be sufficiently long to tuck in firmly on either side, otherwise it will wrinkle and become a source of discomfort.

About the remainder of the bed-clothes a few details must be noted. If the bed is to be smooth, the sheets must be of sufficient size to tuck in firmly at the top and bottom and at the sides. A stout quality muslin, three-quarters of a yard wider than the mattress, should be chosen, and well shrunken before making up. The sheet should be cut three-quarters of a yard longer than the mattress, and hemmed with a two-inch hem at one end and a one-inch hem at the other. If the material is not shrunken before the sheet is made, one yard instead of three-quarters of a yard must be allowed.

The *spread* should be washable and light. The cotton spread manufactured by the Allandale Company is eminently suitable. It is made of stout white dimity, which wears well, is both dainty and serviceable, and has the advantage over the heavier and more loosely woven spreads of not perceptibly shrinking. Though slightly dearer than some other varieties to purchase, it is less expensive in the long run, as it wears much better.

Where the *blankets* can be obtained entirely of wool, they have the advantage of being lighter in proportion to their warmth, and wearing better. For practical purposes, however, a cheaper variety of blanket meets all the requirements. The care of the blankets is such an important part of the economy of a hospital ward that it will be treated at greater length in another chapter. (See *Ward Management*, Chap. XXIV.)

Bed-making.—The simple process of making a bed may be a slovenly, ineffectual performance, or, in skilful hands, a real source of healing and comfort. In teaching a class, and for the routine bed-making of a ward, the nurses should work in pairs; the beds in this way are made more

efficiently and quickly, and with considerably less fatigue on the part of the nurses.

Standing opposite each other on either side of the bed, with a chair placed at the bottom of the bed, on which is laid the clean linen that will be required, the lesson may proceed as follows:

First: Remove the upper clothing, one at a time, by taking the top and bottom corners, laying them together, and folding neatly; lay each article over the back of the empty chair.

Second: When the top sheet is reached, loosen it all round, slip the patient's bed-socks or slippers over his feet, put on his wrapper or other suitable covering, and help him out of bed.

Third: Remove the remaining clothes in the same manner. If any are to be replaced by clean linen, lay the soiled, tidily folded, on one side.

Fourth: Brush the mattress with a whisk-broom and turn it top to bottom.

Fifth: Replace the clothes in their order, thus: rubber sheet, sheet, rubber draw-sheet, and draw-sheet, tucking them all very firmly under the mattress; beat up the pillows and lay them in place.

Sixth: Lay the upper clothes, with the exception of the spread, in order on the bed, turning back the upper border of the sheet over the blankets; the upper margin of the blankets should come just below the pillow; the upper margin of the sheet should reach to the top of the mattress before folding back. Do not tuck them in until the patient has been put back to bed.

Seventh: Return the patient to bed and divest him, under cover of the bed-clothes, of slippers and wrapper.

Eighth: Tuck the clothes in and cover with the spread, which is tucked firmly at the bottom of the mattress and at the top is turned over the upper margin of all the blankets, and in its turn covered by the reversed border of the upper sheet. (This helps to keep the blankets clean, a cotton spread being a simpler thing to wash than a woolen blanket.) Adjust the corners of the spread smartly and the bed is made.

Points which have always to be emphasized in teaching a class are the following:

Have everything at hand before you begin.

See that the temperature of the room is sufficiently warm.

Take care that the patient is not exposed to a draught.

Do not beat up pillows on the patient's bed while he is in it.

All folding must be done at the bottom of the bed, not over the patient's face.

Never lean on a bed, jerk it, or touch it unnecessarily: such practices are always annoying, and in some instances, such as, for example, in rheumatoid arthritis and some forms of septicemia, cause acute pain.

It is also never too early in a nurse's training to point out the necessity of a dignified and quiet demeanor, and a habit of consideration toward the patient. Personal topics should not be discussed while at work.

When the simple making of beds has been mastered with some proficiency, the next lesson may show the methods of changing a bed with a helpless patient in it. This may first be practised with a dummy, or with one of the pupils acting the part of the patient in the demonstration room, or by using a convalescent patient, if one is found who does not object to assisting at a demonstration.

To Change a Medical Bed.—*First:* Arrange a chair and remove the top coverings, as in the first lesson: retain the undermost blanket and untuck it and the upper sheet all round; holding the blanket over the patient by its upper margin, slip the sheet out from under, leaving the patient covered by the blanket.

Second: Loosen the underclothes and remove the pillows (one is practical to retain if preferred).

Third: Turn the patient on one side, keeping the blanket over him, one nurse supporting him by the shoulders and pelvis.

Fourth: Roll the undersheet and draw-sheet from the side farthest from the patient to the middle of the bed, whisk the mattress free of dust, and straighten the rubber sheet; if it is necessary to change it, roll in the same manner as the sheet.

Fifth: Prepare the clean sheet and draw-sheet by rolling one-half from either side toward the middle; lay the rolls by the side of the rolled-up soiled sheet.

Sixth: Unroll the sheet and draw-sheet over the exposed half of the mattress and tuck them firmly in, turn the patient on to the clean sheet, remove the soiled sheets, and unroll and adjust the other half of the clean ones in the same way.

Seventh: Turn the patient on his back and lay the upper sheet over him, not covering his face; slip the covering blanket from under the sheet, and finish the bed in the usual manner (Fig. 1).

Fig. 1.—Changing the under sheet, medical method.

This method is known as changing a *medical* bed, most medical cases being able to be turned on the side. It is also applicable to the majority of surgical cases. What is known as the *surgical method* is employed where turning on the side is impracticable, the majority of cases which, from one reason or another, are forced to retain a fixed position being surgical. It is a somewhat more difficult method, and should not be taught until the pupil has been given some instruction in lifting.

Instead of from side to side, the sheets, by the surgical method, are changed from top to bottom; in other respects the process is the same.

To Change a Surgical Bed.—After proceeding in the usual manner until the pillows are removed and the patient covered with one blanket, the sheet is rolled from the top of the bed down under the patient's head to his shoulders, and the clean one, folded crosswise, is laid beside it and the top tucked in, covering the upper part of the bed. Standing one on each side, the nurses place the hands nearest the head of the bed under the patient's shoulders and raise him sufficiently, and no more, to enable them with their free hands to roll the soiled and the clean sheets under the shoulders to the hips. The pelvis is then raised in the same manner and the limbs in their turn, and the bed is completed in the usual way. When it is necessary to keep a joint or limb at absolute rest, a third nurse is required to support the limb and keep it immovable during the process.

A medical bed can and should have its under sheet removed and replaced or changed once every day. For cases such as have just been described, where immobility is part of the treatment, it should be performed as seldom as is consistent with comfort and cleanliness. A judicious use of draw-sheets will produce like results with much less disturbance of the patient.

Nurses have invariably to be checked in an extravagant use of bed linen. That it is extravagance is difficult to bring home to them in a hospital ward where the supply of linen is bountiful, and the disadvantages of too frequent washing are not evident to the pupil. In a properly organized ward there are set days and intervals for the changing of spreads, curtains, and sheets, and while soiled and stained sheets must obviously always be removed, the pupils should be taught that a sheet may be kept clean and fresh for double the length of time by such simple means as folding it smoothly over a chair during the bath and bed-making; turning it; preventing visitors from sitting on the bed; protecting it with the dinner napkin when food is given, or with a draw-sheet during various

treatments. This may sound a trivial lesson, but if really learnt, its usefulness is far reaching. As one of the results we might cease to hear of private nurses taxing beyond bearing the resources of a small establishment by demanding fresh sheets, etc., at least daily.

To Turn a Top Sheet Without Exposing a Patient.—This is most easily done by two nurses. Standing one on either side of the bed, with the blanket and spread removed, the upper hem of the sheet is taken by the hands furthest

Fig. 2.—Turning top sheet without exposing the patient.

from the head of the bed. The other hands are held extended under the reversed upper border of the sheet and the sheet is drawn by the upper hem over the extended hands toward the bottom of the bed, much as if the uppermost hands formed a roller (Fig. 2).

Where a patient has to remain any length of time in bed, it is often an immense comfort to turn his mattress, or to put him on a fresh mattress. Instruction in the method of so doing follows naturally the lessons in bed-making.

To Turn a Mattress Under the Patient.—*First:* Proceed as in bed-making until the pillows are removed and the patient covered with the single blanket.

Second: Move the patient to one side of the mattress, loosen the clothes, and roll them from either side closely up to him.

Third: Take hold of the mattress from the side furthest from the patient, and draw it across the bed until half the wire mattress is exposed.

Fig. 3.—Turning a mattress without removing the patient from the bed.

Fourth: Cover the exposed wire mattress with pillows (three are enough) and move the patient, with the bedclothes under him, on to the pillows.

Fifth: Turn the mattress from top to bottom (if advisable, make it up with clean sheet and draw-sheet), move the patient on to it, remove the pillows, and draw the mattress back into position (Fig. 3).

To Give a Fresh Mattress.—In a ward it is usually as simple a matter to give a fresh mattress as to turn one already in use. Two methods may be employed:

First Method: Proceed as though turning the mattress, but, instead of using the pillows, when the mattress is drawn across the bed, place a fresh mattress already made up with sheet, etc., beside it, and move the patient upon it. Remove the old mattress and draw the fresh one into place.

Second Method: Roll a second bed on which is a mattress without covers close to that of the patient. Divest the bed of the upper clothes and pillows, cover the patient with a single blanket, and loosen the under bed-clothes. Two nurses standing at the further side of the empty bed take hold of the under sheet by the sides, and, slightly raising it, pull it toward them with the patient on it, helped, at the samè time by a third nurse, who remains at the further side of the patient's bed. Where the bedstead is of cot formation with low railings at top and bottom, two nurses stand at the patient's head and feet and lift him in the sheet as though on a stretcher. Where a patient can be lifted bodily from one bed to another (or on to a couch or stretcher), the second bed is wheeled up in such a manner that the bottom of one is opposite the top of the other. Three nurses standing between the two beds lift the patient, one at the shoulders, one supporting the pelvis, and one at the feet; with the beds so arranged, by the nurses simply turning round in a half wheel, the patient is in the right position to be laid on the fresh bed.

The Bed-bath.—After bed-making has been mastered, instruction in giving the ordinary cleansing bed-bath follows:

The requirements for its performance are,—a covering for the patient, a covering to protect the bed-clothes, hot water in a deep basin, a further supply in a pitcher, a slop jar, a face towel, and a second towel, thicker and heavier, two wash-cloths, a bottle of alcohol, and a box of talcum or starch powder. The water in the basin should be 105° F., that in the pitcher, 110° F.

The bath may be greatly elaborated with scented soaps and powders, and a variety of towels and sponges, or

greatly simplified, as where a bowl, a small piece of soap, and a fragment of towel are all the implements procurable.

The coverings usually employed are old blankets, one placed under the patient and one kept over him during the bath. Where not obtainable, a half-soiled sheet, folded in four thicknesses, or a large bath towel, may be used under the patient and one of his bed blankets used to cover him, care being taken by the use of towels to prevent the latter becoming damp.

Fig. 4.—Washing a patient without exposure.

Where obtainable, a hot-water bag ready filled should be at hand, and in most instances may with advantage be kept at the patient's feet during the whole process. Care must be taken that the room is warm and draughts excluded.

The upper bed-clothes removed and the blankets in place, the night-shirt is removed and the bathing proceeds as follows, the nurse standing at the right-hand side of the bed (Fig. 4).

First: Sponge and dry the face: wash with a good lather of suds the neck and ears, rinse well, and dry, taking particular care with the ears.

Second: Bring each arm in turn out over the upper blanket, place the basin on the bed, and put the hand in the water, soaping and rubbing it between your own hands. Keep each hand in the water while the arm is washed. Rinse, dry thoroughly, and repeat the process with the other arm.

Third (the second wash-cloth is now used): Wash the chest and abdomen. This may or may not be done under cover, at discretion. Where a patient is washed under cover, the blanket is with one hand held slightly away from the body, while the other hand performs the washing and drying. The entire patient may be washed in this way, and should be so done where discretion suggests, or where the patient is peculiarly susceptible to chill, as in conditions of great weakness.

The axilla and umbilicus must receive special care. If the umbilicus has been neglected and allowed to become blocked with secretion and dust difficult to remove, a small soap poultice may be applied twice a day until clean. (See *Preparation for Operation*, p. 553.)

Fourth: The chest and abdomen dried and covered, the genitals are carefully washed under cover. In many cases patients can do this for themselves with some little assistance from the nurse. With helpless or unconscious patients it must not be neglected from a false notion of delicacy, the skin in these parts becoming easily inflamed and sore from the natural secretions, unless kept scrupulously clean. The folds of the thighs should receive special attention.

Where the parts have become irritated, or from any cause are difficult to cleanse (such as during menstruation), such washing may be left to the end of the bath, and the patient placed on a douche pan, filled with hot water, and given a thorough local tubbing.

Fifth: At this point the water usually requires changing and the basin is replenished from the pitcher.

The lower limbs are now exposed in turn, washed and

dried in turn in the same way as the arms, with the basin on the bed and the foot kept in the hot water. This method of bathing the limbs demands a little more dexterity, so as not to upset the basin, and cannot be used with a restless patient, but it is usually found immensely comfortable for the patient, and is a good means of restoring the bodily warmth, which is always slightly lost in washing.

Sixth: The patient is rolled over on his face and the back and hips washed.

If it is an object, as in many cases, to spare the patient's strength, the under sheet may now be changed, and the patient turned on to the freshly made half of the bed, the under washing blanket is removed with the soiled sheet, the entire bath and bed-making being thus accomplished with only one turning of the patient, a consideration when the store of strength is small.

Seventh: Before the shirt is replaced the back, hips, and other points of pressure are usually well rubbed with alcohol and powdered.

Eighth: The shirt is replaced and the bed made.

The bed-bath is usually the most acceptable if the washing is done briskly with plentiful soap, thorough rinsing, and a fairly vigorous friction with a *dry* towel, none of which is incompatible with gentleness; the unpleasantness and inadequacy of a dabbing wash with a wash-cloth wrung nearly dry, followed by a gentle wiping, has to be experienced to be realized.

Changing the Shirt.—In removing a patient's shirt, loosen it round the neck, bring the back half over the shoulders, and draw off one sleeve, when the shirt will slip easily over the head and be withdrawn by the second sleeve. Should one arm or side be injured, begin always with the sound arm.

In putting on a shirt, reverse the proceedings, thus, first one sleeve, *an injured arm first*, then over the head, then the second sleeve, and finally pull it down comfortably under the patient. In putting on the sleeve make it as short as possible by gathering the wristband up toward the arm-hole, and so slipping the entire sleeve over the wrist with one movement.

Simple as this lesson sounds, usually it has to be practised again and again before it is accomplished with deftness, and with no fatigue for the patient.

For hospital use a very practical shirt is often supplied, buttoning behind, with the front part the usual length and the back reaching only to the waist. It is comfortable for such patients as are forced to lie down, and can be changed quickly. Its disadvantages are that it is frequently used for patients that can sit up, where it is obviously unsuitable, and that its use leads pupil nurses to believe they cannot nurse a bedridden patient with the ordinary night-shirts. As a consequence, many nurses invariably tear their patient's shirts the whole length behind, regardless of the fact that they are needlessly destroying property not their own, and incurring just censure for extravagance and wastefulness. In the few instances in which such a shirt is the best for a patient's welfare, the oldest shirts should be asked for, and should be neatly altered to suit the requirements, not, as is the too frequent method, simply torn and fastened with a safety-pin.

Care of the Mouth.—Where a patient is capable of doing so, he should brush his teeth in the ordinary way at least morning and evening. Where he cannot do so, his mouth should receive the most careful attention from the nurse.

In almost all forms of illness, and frequently in patients on a purely liquid diet, the tongue will be found covered with a coating or *fur* which is largely composed of food-particles, epithelial scales from the mucous membrane of the mouth, and bacteria, mixed with the secretions of the mouth. If the mouth is not kept sufficiently clean, the fur accumulates and spreads to the teeth, gums, and lips in the form of a thick, tenacious, brown deposit, difficult to remove, and known as *sordes* (pronounce *sordees*). In health the muscular action of the tongue, cheeks, and lips in the process of chewing food keeps the mouth free from such deposits.

In severe illness the tongue may become intensely dry and dark in color, while deep cracks or fissures appear, difficult to cleanse or to cure. Not infrequently a neglected

mouth becomes ulcerated, the ulcers extending to the gums and cheeks and causing acute suffering.

It should be borne in mind that a neglected mouth is a menace to the entire system. The mouth is freely supplied with lymphatics ready to carry the products of infection over all the body. It presents an ideal condition for the development of the disease-producing germs, which require for their development moisture, warmth, absence of light, and suitable food, which they find in the body in its organic tissue; and we know that the germs of many diseases are found in the mouth, even in health. Many cases of reinfection in typhoid fever are considered attributable to a neglected mouth, while the frequency with which the adjacent glands or the middle ear become infected in illnesses associated with abnormal conditions of the throat or mouth is a familiar example of the necessity for vigilant cleanliness.

Fig. 5.—Tray for care of mouth.

A small tray (a white enamel pie-dish will serve) (Fig. 5) may be fitted up with the requisites for cleansing the mouth. These consist of a bottle of mouth-wash, a small tumbler or gallipot into which the amount required at one time—and no more—is poured, and a second gallipot to hold a supply of applicators. The most practical are made of short sticks of match-wood, to one end of which are attached pledgets of absorbent cotton. The pledget is formed of a strand of absorbent cotton wound on the end of the applicator. It should not be thick. As the fingers must be used in mounting the cotton on the applicators, the hands must be scrupulously clean. The habit of wrapping a piece of gauze round the finger and so cleansing the patient's mouth should not be permitted. It is

clumsy, unpleasant for both patient and nurse, and, except with infants, inadequate. For infants it is practical, the natural sucking movements helping in the cleansing.

Pass the applicator, moistened in the mouth-wash, carefully and repeatedly over the tongue and every corner of the mouth, paying special attention to the roof of the mouth and the crevices between the gums and cheek, and changing the applicator frequently. Repeat the process until all the deposit that is movable is removed. Do not dip a used applicator into the mouth-wash, but use a fresh one each time. If the patient is strong enough, let him rinse his mouth after into a small receiver.

Lay each applicator after use on the tray; later it may be washed, disinfected, remounted, and used again for the same patient, the soiled pledgets being removed *with forceps*. Where the mouth contains an open wound, as after a mouth operation, or in a case of compound fracture of the jaw, the applicators must be sterilized like any other surgical dressing, and may be put up conveniently in packets of half a dozen ready for use.

A *mouth-wash* should be antiseptic and cleansing and have no unpleasant taste or property injurious to the mucous membrane. Strong antiseptics or powerful drugs are not suitable, owing to the danger of absorption, and, if necessary to be used, should be followed by thorough rinsing with sterile water. They should never be employed for children who are apt to swallow the mouth-wash. The most commonly used are listerine and water; boric acid and water, alone or mixed with a little glycerin and lemon-juice; myrrh or thymol well diluted; chlorate of potash (5 grains to the ounce of water), and permanganate of potash, a few crystals to a tumbler of water. The latter is the least expensive and is frequently used in district work. Where the mouth is in danger of becoming infected, as in the case where cracks and fissures have formed, equal parts of lime-water and peroxid (dioxid) of hydrogen is the most efficacious wash, but the mouth should be carefully rinsed after its use. Where the mouth is very dry or ulcerated, a light application of albolene or dilute boroglycerid after the cleansing is beneficial. Glycerin

alone, although healing, is too astringent. In cases of severe ulceration special applications are usually ordered, such as solution of chlorate of potash, nitrate of silver, sulphate of copper, and so forth. The cleansing of the mouth should precede the application.

Patients on a liquid diet should have their mouths cleansed before each feeding. To cleanse after is apt to induce retching and possibly vomiting. Where the tongue is brown and cracked, marked improvement is shown if the patient is induced to drink water freely. Fever patients who from the beginning have had plenty of water much less frequently develop the brown, dry, and fissured tongue. The point should be impressed on nurses, who are somewhat apt to give water only when the patient complains of thirst.

Care of the Back.—Prevention and Treatment of Bed-sores.—After the daily bath, as has already been said, the back, hips, and other points of pressure should be rubbed with alcohol and dusted with powder—usually starch or borated talcum; rice, zinc, or perfumed powders, equally efficacious, are more expensive. The reason for the rubbing is twofold: by thorough drying to prevent the skin from becoming chafed, and by friction to restore the circulation to parts where, from continued pressure, it is in danger of becoming lessened. The points of pressure in order of their importance are: the coccyx (the prominence at the end of the spine), the hips, elbows, heels, shoulders, the inner surfaces of the ankles and knees, and the back of the head, the latter chiefly in young children. All, it will be observed, are bony prominences protected only by a thin covering of skin.

With no other cause the weight of the body for a lengthened period on one spot is sufficient to produce redness of that part, with a sensation of heat, aching, and discomfort. If these symptoms are neglected, we have the first stage of a bed-sore. From the beginning of her training it cannot be too emphatically laid before the pupil that for a patient in her charge to acquire a bed-sore points to culpable neglect on her part, so rare are the cases in which it may be considered unpreventable.

Besides pressure from the weight of the body, the common causes of a bed-sore are moisture, wrinkles in the bed-clothes, crumbs in the bed, want of cleanliness, and bruising from the careless giving of a bed-pan.

The most important part of the treatment of a bed-sore is to prevent its forming. To accomplish this, prevent pressure, or relieve it by change of position at the first sign of discomfort or appearance of redness, and practise a methodic and systematic routine of cleanliness. Wash the parts daily with soap and water, drying thoroughly and following the operation by a thorough alcohol rub and powdering. Repeat the alcohol rub in the middle of the day and in the evening, at the same time brushing the bed free of crumbs and drawing and smoothing the draw-sheet. For emaciated patients, or patients in whom, for a variety of causes, the circulation is feeble, the above will not be sufficient. Many cases occur where the position should be changed every hour, and the parts that have borne the weight carefully rubbed and powdered with each turning. In ward work the hours at which a patient's " back " is to be rubbed and attended to should be assigned as carefully as the hours at which his medicines are to be administered, and as punctually adhered to.

In some patients the skin has a tendency to chafing and the formation of cracks. In these cases the skin may be preserved whole by an application of castor oil and collodion, equal parts, painted over the surface and re-applied when necessary. The dressing is not, however, any protection from pressure-sores.

Bed-sores may be broadly classed under two headings: those caused by an abrasion of the outer skin and those caused by restriction of the circulation. The former appear first as a redness of the parts if over a prominence, or as a crack in a fold of flesh, such as in the groin or the fold of the buttocks. A few hours' neglect is sufficient for the skin to break, and we presently have a shallow sore with a moist surface, surrounded by sound flesh. This is the mildest form of the bed-sore, and if checked at this point, may heal quickly. Pressure must be at once removed either by change of position or a judicious

arrangement of pillows. The wound must be kept surgically clean and dry, the surrounding tissues sound. If the crack is in a fold of flesh, the surfaces must be kept apart. The most satisfactory application is a sterile, mildly antiseptic dusting-powder constantly applied, such as starch or talcum and boric, starch and zinc, or stearate of zinc; the latter is, however, much more expensive than the others. Ointments are at the present day out of favor, but in cases difficult to keep dry a piece of lint spread with zinc ointment the size of the sore, covered with a piece of sterile gauze, and held in place by strips of adhesive strapping, is frequently a successful dressing. If the sore is progressing favorably, the surface will become clean and dry, and new granulations, in the form of bright red specks, may be observed. We have, however, a wounded surface, and, as in all wounds, there is consequently danger of infection. The signs of such infection are discharge and local inflammation; the granulations are pale and unhealthy; the sore, instead of healing, grows deep. The bed-sore is treated like any other surgical wound that is not healing by first intention. It is cleansed with an antiseptic solution, and, usually after powdering, lightly packed with gauze and covered with a gauze pad. If stimulation is required, the surface is sometimes touched with nitrate of silver or blue stone, or an astringent lotion, such as zinc wash, may be used. The dressing is renewed whenever it has become damp or soiled. Such bed-sores, beginning mildly, may become large, deep ulcers, causing great suffering and taking weeks to heal.

The second variety of bed-sore has, at the beginning, the appearance of a bruised spot, dark purple in color, and occurring most frequently over the coccyx. It is the result of pressure, and sometimes caused by such an apparently trifling matter as leaving a patient for a length of time with his back pressing on a bed-pan. Only rarely is it possible to avert a bed-sore once this bruised spot is noticed. This variety of sore is also caused by badly adjusted splints or mechanical appliances. Pressure must be promptly relieved, and the surrounding tissues gently

but thoroughly rubbed to restore the circulation. The remedies advocated at this stage are bathing with very hot water for ten minutes at a time, repeated hourly, painting the surface with the three tinctures (tincture of aconite, $1\frac{1}{2}$ drams, tincture of opium, $1\frac{1}{2}$ drams, tincture of iodin, 5 drams), or strapping applied directly over the discolored spot. At the very first symptom of discoloration each of these remedies has been known to have good results, especially if pressure can be entirely removed. Frequently, however, it is apparent that a slough has already formed which must come away before healing can begin. A slough is a piece of dead flesh in living flesh, and is the same thing in soft tissues that a sequestrum or necrosed bone is in hard tissue (p. 643). It cannot be revitalized or absorbed. When a slough has remained attached until it has become decomposed, it is called a gangrene, and has a characteristic, very offensive odor. The separation of the slough may be hastened by the application of hot compresses or a small poultice cut exactly the size of the slough, and covered, when applied, with some moisture-proof protective, such as light mackintosh sheeting or gutta-percha tissue. When the slough begins to separate, it must never be pulled away, or hemorrhage, difficult to control, may result. When the slough is shed, a correspondingly deep sore is revealed, with a discharging, irregular surface. Probing will frequently discover small channels burrowing more deeply into the tissues. Such sores are very liable to secondary infection and to increase in size with rapidity, sometimes becoming so large as to threaten life from the drain they cause to the system, and from the toxins absorbed.

The treatment aims at preventing infection and inducing healing: usually the bed-sore is cleaned with peroxid of hydrogen daily, and packed with sterile gauze, sometimes soaked with such preparations as bovinin, balsam of Peru, or a weak solution of zinc (2 grains to the ounce), known as red wash; or the surface is dusted with sterile dusting-powder and packed with dry gauze. The dressing must be performed under strict surgical asepsis. If the surface is extensive, poisonous applications must be used

with caution. Patients have exhibited symptoms of acetanilid poison from the use of acetanilid in the dusting-powder of a bed-sore insignificant in size. Where the surface of the wound is pale and unhealthy in appearance, it is usual, from time to time, to use a stringent application in the dressing. Usually the surface is painted with a solution of nitrate of silver (2 grains to the ounce), or the silver stick (lunar caustic) is applied directly. If, on healing, the granulations have a tendency to become redundant, the same treatment is also followed to reduce them. When the bed-sore is healing properly, the discharge decreases, the surface is a healthy red color, and the wound is perceptibly smaller day by day. Not only will the cavity close up from the bottom, but healing will be carried on from the margins of the wound, as in the case of an ulcer.

Sometimes the first appearance of a bed-sore is a reddened area, which is also *puffy* or *swollen*, with one or more clear blisters formed on the surface. The blister results from a pinching of the swollen tissue which has caused a small local exudation of lymph. If pressure is removed, the part rubbed thoroughly and powdered, care being taken not to break the blister, the symptoms will frequently subside and the contents of the blister be gradually absorbed. If the blister breaks, it is a sore similar to those first described. The cuticle of the blister should not be cut away unless the sore becomes infected, when a free surface is a more favorable condition than a covered surface.

It should be a strict rule in all wards that the earliest symptoms of a bed-sore should be reported to the head nurse, and by her to the doctor. This is sometimes neglected from a dislike of incurring blame.

To Relieve Pressure.—Where the patient may be turned, to turn him is the best means of relieving pressure. Where the position is fixed, pressure may be relieved by the adjustment of pillows of various sizes or the use of a ring cushion. Ring cushions are made of rubber in ring shape and inflated with air. They should be inflated just sufficiently to relieve the pressure and no more, otherwise they

are hard and uncomfortable. They may be covered with a clean gauze bandage wound smoothly round and round the ring. Besides the ring pillow of rubber, small rings of many sizes may be cut out of muslin and stuffed with tow pulled smooth or with non-absorbent cotton. They are invaluable in removing pressure from such points as the heels, knees, elbows, or ankle bones. Small pads and pillows may be used in the same way and can be made any suitable size, from a few inches square up. If necessary, they may be kept in position by a light bandage.

Where, as in cases greatly emaciated, there is a tendency to redness in many parts of the body, the patient may be nursed on an *air-* or *water-bed*. Such a bed consists of a rubber mattress, either inflated with air or filled with water, and placed above the ordinary mattress, and generally proves an immense comfort to the patient. To prevent sagging, two or three boards should be placed across the bed under the wire mattress, or the hair mattress may be replaced by a straw palliasse. The rubber mattress should be protected by a rubber sheet and a blanket tucked well in before the usual bed-clothes are arranged in place. *The smallest pin-prick will spoil the entire usefulness of the mattress*, each of which cost from $25 to $40.

If water is used, it should be at a temperature comfortably warm, and watch must be kept from time to time to see that the warmth is maintained. If it becomes chilled, some of the water is removed and hot water added, which can be done without taking the patient off the mattress.

In order to place a patient on a water-bed the best method is to prepare it on a second bed and then move the patient. Where this is not possible, the empty rubber bed may be placed under the patient in the same way that a sheet is rolled beneath him, and filled, when in place, with remarkably little disturbance of the patient.

To Give a Bed-pan.—The careless giving of a bed-pan may so bruise the coccyx as to lead to the formation of a bed-sore. This small office for the sick may be a source of acute discomfort if done roughly or without due regard

for the natural delicacy of a patient. No bed-pan should be given without a screen round the bed or the bed-curtains drawn, and this rule should be equally enforced at night and in children's wards.

To give the bed-pan, place the left hand under the pelvis and raise the patient sufficiently, directing him at the same time slightly to draw the knees up and press the heels against the bed; with the right hand slide the pan under the patient, and gently lower him in the proper position. Have a folded towel or suitable pad where the patient's back will rest, and avoid knocking the back with rough or jerky movements. Where patients are unable to attend to themselves after its use it must be done for them, as quietly and as much as a matter of course as any other service rendered.

Bed-pans are made in several shapes; that, however, similar to those supplied by Meinecke and Company, No. 48 Park Place, New York, and named the Perfection, is at present in almost universal use in hospitals. It is simple to clean and comfortable for the patient. It comes in either porcelain or gray or white enamel; the enamel, although more expensive to begin with, is cheaper in the end, as with reasonable care to prevent chipping the enamel will last a very long time in good condition. Another shape which fulfils an occasional want is the slipper bed-pan, made in the shape of a wedge. It is of use where, either from extraordinary weight or from the necessity of a specially fixed position, the patient cannot be raised from the bed even the few inches necessary to place the usual bed-pan in position. Bed-pans may also be obtained made entirely of rubber. They are chiefly used in cases of incontinence where it may be necessary to keep the bed-pan permanently under the patient. (See *Care of Rubber*, p. 459.)

In carrying a bed-pan to and from a patient, it should invariably be covered. A piece of stout cotton or ticking three-quarters of a yard square makes an adequate covering, and must be kept strictly for its purpose.

After use, the bed-pan must be at once removed and washed, first in a stream of cold water, and then thoroughly

mopped and rinsed with hot water. If the case is an infectious one, it may be necessary to mix the contents thoroughly with a disinfectant and allow it to stand for a given time. In this case it must be closely covered and emptied as soon as possible. (See *Infection and Immunity.*)

From the beginning nurses must be taught that the condition of the excreta is an important indication of many conditions of the system (see *Excreta*), and they should be trained to detect any deviation from the normal and to report to the head nurse, and save for her inspection any stool or specimen in any way unusual.

Care of the Hair.—In a woman's ward the proper care of the patient's hair is a considerable item in the daily work. The hair should be thoroughly brushed once a day, and again, not necessarily so thoroughly, at the evening toilet. For a patient lying down it is most conveniently arranged by parting the hair from brow to the back of the neck and braiding it on either side of the head. In this way it is kept free of tangles, is easily groomed, and is out of the way of the patient.

Where the hair has become badly tangled through carelessness or want of skill, it requires an immense amount of patience and considerable skill to disentangle it without torturing the patient. Vaselin or sweet oil rubbed freely into the hair will help matters. The hair should then be brushed, a small portion at a time, beginning at the ends, and not at the roots. To avoid tugging on the roots, each strand should be held firmly in the left hand just above the portion being brushed. The portion free of tangles is then braided, and the next portion attacked.

It is customary to wash the heads of ward patients on admission to the ward. Where a patient is unable to get out of bed, proceed as follows (Fig. 6):

First: Provide, on a convenient table, a deep basin with hot water (temp., 105° F.), a pitcher of water (110° F.), a slop-jar, a bottle of liquid green soap, a small pitcher, towels, a small rubber sheet, and a Kelly pad. Where a Kelly pad (p. 548) is not available, one can be improvised by rolling a small blanket into one end of a rubber sheet

and folding into a horseshoe shape, the free end acting as the apron of the Kelly pad.

Second: Place the Kelly pad under the patient's head near the edge of the bed. Arrange so that cheek and side of the neck rest on the inflated rim of the pad, with the hair brushed away from the face. The apron of the Kelly pad is directed into the slop-pail, which is conveniently placed below the bed.

Fig. 6.—Washing the hair of a woman patient in bed.

Third: Fold a small rubber sheet covered with a towel closely round the neck (a bath towel preferably), and pin them securely in place; roll a second small towel, pass it from the back of the neck over the ears across the brow above the eyes, taking care to cover none of the hair; secure it firmly with a safety-pin.

Fourth: Wash the hair, first wetting it, then pouring on

sufficient soap and massaging the scalp thoroughly with the hands moving in opposite directions. Repeat with fresh water until clean. A little ammonia may be added to the first water with advantage.

Fifth: Rinse by pouring water over the head with the small pitcher, moving the hair about so that the roots are reached.

Sixth: When thoroughly rinsed, wring the hair gently with both hands, remove the Kelly pad, and replace it with the small rubber sheet from the shoulders; unpin the large towel and turn it over the entire head; remove the rolled face towel and rub the hair until dry. The drying process may be hastened by fanning with one hand, at the same time separating the strands of hair with the other. In washing the hair it must be closely examined for pediculi, which are very common among ward patients. The eggs appear very much like specks of dandruff, but adhere closely to the hair and cannot be removed by a fine comb. All heads in a general ward should be closely combed on admission, and if either pediculi or eggs (nits) are found, should be treated until cured with a head lotion and careful combing.

To Treat a Head With Pediculi.—After washing, the hair is soaked either in a disinfectant, such as bichlorid of mercury, 1 : 500, carbolic acid, 1 : 40, in tincture of larkspur, or in coal oil, and is then wrapped in a triangular bandage or towel. If coal oil is used, care must be taken that *no* friction is used and that no lamp or other light is allowed near. Frequently, in the homes of the poor, coal oil is the only available remedy. The coal oil may be applied at bedtime. The next morning the hair is soaked in hot vinegar and water (equal parts), which will soften and in time dissolve the nits, and carefully combed with a fine comb. The process is repeated until the pediculi have disappeared. In a hospital ward it is usually desirable to use a head lotion and thorough combing daily. Tincture of larkspur or bichlorid of mercury 1 : 1000 are the lotions generally preferred.

Where pediculi are found on the hair of the body, a daily bath of soap and water should be given, followed by a

sponging with bichlorid of mercury 1 : 2000, and an application of tincture of larkspur to the affected parts, shaving where necessary. The clothes of such patients are best destroyed, but where this is impracticable, they may be disinfected with the fumes of sulphur, or baked in an autoclave and subsequently washed.

Lifting a Patient.—Lifting, raising, or turning a patient is, it is generally conceded, rather a question of skill and knack than of actual strength, and the doing of it with the greatest degree of comfort for the patient, and the least physical strain for the lifter, comes only with repeated practice.

For this lesson nurses should work in pairs. A few words of preliminary instruction should emphasize some simple rules not always remembered.

First: Loosen the bed-clothes in the first place, so that your movements may be unhampered, and arrange them so that the patient will not become uncovered.

Second: Work in unison.

Third: Use the whole hand, not just the fingers.

Fourth: Avoid all jerking, pulling, and ineffectual movement; each movement should accomplish its definite purpose.

Fifth: Bend from the knees and hips, not from the back.

To Turn.—One nurse is usually sufficient for this process. Stand on the side to which the patient is to turn. Reach across the patient, and place the open hands, firmly, one behind the shoulders and one over the pelvis about the end of the spine, and draw the patient toward you. In cases of extreme weakness the head must be supported by a second nurse.

Where a patient is unusually heavy and helpless, a draw-sheet or stout towel may be slipped under the shoulders and under the pelvis respectively, the further ends of which are then grasped and drawn by the nurse toward her, thus at the same time rolling the patient into the required position.

To Lift in Bed.—*First:* Stand on either side of the bed about the level of the patient's shoulder.

Second: Place one arm below the patient's shoulders and grasp him as far toward the opposite axilla as can be

done easily (to strain will produce a jerking movement); pass the other hand and arm *as far as is easily done* in the same way below the pelvis toward the opposite hip.

Third: Then lift simultaneously.

Patients may likewise be lifted as well as turned by the help of a draw-sheet or towel placed under the pelvis and under the shoulders. Each nurse grasps the ends of the draw-sheet on her side, and working in unison with the opposite nurse, lifts the patient slightly from the bed and lays him down in the required position. Where even such slight movement is accompanied by risk, lifting may be accomplished with the minimum amount of movement by loosening the under sheet, rolling each side toward the patient, grasping it from opposite sides on a level with the shoulder and just below the pelvis, and lifting the patient with the sheet.

To Raise a Patient into a Sitting Posture.—One nurse is generally sufficient. Stand beside the patient's right shoulder, pass the left arm over the shoulder to the opposite axilla, and the right under the near arm below the shoulder, toward the middle of the back; direct the patient to pass his right arm under the nurse's right, and bring his hand over on to her shoulder, and the raising, even of a heavy patient, is accomplished very easily.

Lifting may also be made more easy when the patient can help himself slightly in this way. The amateur method, which is to direct the patient to place his arms round the nurse's neck, hampers her movements and leaves both the nurse and patient breathless. In many hospitals each bed is provided with a pulley attached to a strong iron bracket or hanging from the ceiling. By holding on to this a patient can, with very little exertion on his part, immensely help the nurse in lifting.

To Lift From the Bed.—For this purpose the nurses must both stand on the same side of the bed.

When the patient can sit up, he can be placed sitting at the edge of the bed. The nurses pass their arms behind the shoulders and below the pelvis, and grasp each other's arms firmly. The patient helps by placing his hand on the shoulders of the nurses—either the nearest

shoulder or the further, according to the size of the patient. In this way a patient may be carried some distance with little effort. It is important to remember that, in carrying, the bearers *keep step out of step*, that is to say, instead of both right and both left feet stepping together, the right keeps time with the opposite left, otherwise the patient will be jerked.

To return a patient to bed, first set him on the side of the bed, then lift his feet on to the bed, and finally lower his shoulders.

The method of lifting a recumbent patient from his bed has already been described in the directions on changing the mattress.

In carrying a patient on a stretcher, he should be carried *feet foremost;* again it is necessary to remember to walk moving the *opposite* feet simultaneously in order to avoid jerking. The reason for this is very simply demonstrated by getting two nurses to carry between them a bucket full of water. If they keep step in the usual way, the water will be spilt.

To Arrange a Patient in Bed.—When a patient is too weak to support himself in the sitting posture, or in those pitiful cases where no other posture is possible, some ingenuity is required to make the position a comfortable one, and to prevent the patient slipping. While there may be fifty ways of arranging the pillows to suit one case, some simple methods of keeping a patient comfortable in an upright position may be demonstrated.

A bed-rest is more comfortable than a pile of pillows, as it better retains its shape and position. Bed-rests come in many devices, from the simple wooden frame filled in with crossed pieces of webbing and attached in a slanting position to the railing at the head of the bed, to the upholstered variety, something like the top of an armchair, which can be raised and lowered from a graduated frame. Those used in hospitals should be capable of being easily cleaned and disinfected. On the bed-rest a couple of pillows at least will be needed—one upright for the back, and one across for the head and shoulders. A tiny one, placed just below the back of the head, is a very

comfortable addition. Small pillows should be arranged under either elbow.

To maintain this position many devices have been tried, none of which are at all times successful.

First: A pillow tied into a firm roll may be placed below the pelvis and kept in place by passing a bandage through the roll and tying the ends to the bed-frame.

Second: A pillow filled with sand may be placed just below the pelvis, and, as it retains its shape and position,

Fig. 7.—Showing foot-sling, for supporting patient in the upright position.

is found much more comfortable than it sounds. A second sand-pillow should be placed for the feet to press against.

Third: The foot-sling may be used (Fig. 7). This consists of a sheet folded four or six times lengthwise, with a piece of tape tied firmly to each end. The sheet is passed across the bed and tied by the tape on either side to the railing at the head of the bed at the right distance, so that the patient's feet may rest firmly against the sling. A small, well-filled pillow is placed below the knees. This

method is usually the most reliable. The sling may be modified by wrapping in the sheet, where the feet would rest, a small pillow or a small pillow made more stiff by being attached to a small piece of board.

Where the upright position is maintained, the skin over the coccyx will require the greatest care. The patient may be nursed entirely on an air- or water-bed, or pressure may be lessened by using an air- or water-ring cushion, *not too much inflated.* Where this is done, the patient may complain of feeling his feet too low, a very fatiguing sensation. This can be remedied by raising the lower end of the bed on small blocks, or by placing a blanket folded into several thicknesses below the lower half of the mattress.

The above demonstrations may constitute the practical lessons given to the pupil nurses in their first two weeks, and must, to insure perfection, be constantly practised during the junior and intermediate years. Quickness should not be enforced at first: it is too apt to mean scamped work. Quickness should follow when practice has made perfect.

From the earliest days pupils should be taught quiet and dignified behavior while at their work, and habits of consideration and kindness toward their patients. No conversation on personal topics should be allowed in the wards, and no raised voices or noisy movements.

CHAPTER II

BATHS AND PACKS

General Rules—Hot Tub-bath for Cleansing, to Induce Perspiration, to Relieve Convulsions—Sitz-bath—Foot-bath—Constant Immersion—Local Baths—Cold Tub-bath—Brandt Bath—Medicated Baths—Hot Pack—Dry Pack—Hot-air Bath—Vapor Bath—Electric-light Bath—Cold Sponge—Drip Sponge—Affusion—Ice-rub—Ice Cradling—Paddling—Cold Pack.

A BATH, strictly speaking, is a means by which the body is *immersed*, usually in water, though in special conditions other media, such as vapor, hot air, or the mud or sand of special districts, is used. The bath may be general, including the entire body, or *local*, as when a limb only is immersed. The hot bath with a good simple soap is the best means of keeping the skin in a clean and active condition; the cold plunge bath, one of the best tonics to the skin and circulation—by stimulating the circulation, the processes of elimination and metabolism are also increased.

The bath is also a valuable therapeutic agent, and as such is employed at different temperatures in a large variety of circumstances. The *hot* bath is used to induce perspiration, to relax local spasms or general convulsions, to restore bodily warmth, to relieve pain and inflammation, to relieve retention of urine, as a sedative in some nervous conditions, and as a stimulant in cases of collapse. It is a simple agent in relieving fatigue and soothing nervous irritability, and, in the milder forms of insomnia, may induce sleep. The *cold* tub-bath is used to reduce temperature, to stimulate a sluggish circulation, to reduce inflammation, and as a tonic, either to invigorate the system, or in the case of some nervous conditions.

For therapeutic purposes medicinal agents are frequently combined with the bath, as, for example, the hot mustard bath, for purposes of stimulation; the mercurial vapor

bath in the treatment of syphilis; the tub-bath with sulphur, bran, etc., in the treatment of some skin affections.

The temperatures usually ordered for the bath may be divided as follows:

Cold bath, 40°–70° F.
Cool bath, 70°–80° F.
Tepid bath, 80°–90° F.
Warm bath, 90°–100° F.
Hot bath, 100°–110° F.

In giving any bath certain general conditions must be observed.

A bath is not given immediately after food. One hour after a light meal and two hours after a full dinner should be allowed to elapse. The reason for this is that the bath, by causing the superficial blood-vessels of the body to dilate and become filled with blood, diverts the blood-supply from the digestive organs, which, during digestion, require an increased supply of blood for their work. In consequence we get the condition of arrested digestion, with the characteristic symptoms of acute headache, local pain, nausea, and vomiting.

No patient should remain in hot water long enough to become exhausted. Five or ten minutes is sufficient for a cleansing bath. A nurse should understand clearly the effect to be desired in giving the bath, the most prompt and exact manner of giving it, the symptoms, toward and untoward, to be watched for; she should also realize the importance of keeping closely to orders concerning the temperature of the bath and the length of time for which the treatment is to be continued.

The bath-room should be well ventilated, free from draughts, and kept at a temperature of 60° to 65° F. A higher temperature is not advisable, the bath-room becoming rapidly overheated while giving a hot bath. With hospital patients three rules should be strictly enforced, and may with advantage be posted in a prominent place in the bath-room:

1. Every patient in taking a bath must be accompanied by a nurse (or an orderly), unless by a special written order

to the contrary, in which case the door must never be locked.

2. In every case the temperature of the bath must be taken with the bath thermometer.

3. In drawing a bath, some cold water must always be run in first. The latter rule is chiefly in order to preserve the bath-tub from abuse. The boiling hot water found in institutions is sufficient to crack a glass or porcelain tub or to destroy the paint of a painted wood or metal tub. In time it will also spoil the polished surface of an enameled iron tub, which otherwise best resists it. It is also a wise precaution in another sense. Cases are on record where, the hot water only in the bath, a child has accidentally been placed in the water and scalded.

The Cleansing Bath.—On admission to a hospital a patient, if he is in appropriate bodily condition, is usually ordered a tub-bath. Opinion differs greatly as to what constitutes an appropriate bodily condition. Some doctors prefer the bed-bath if the patient's temperature is over 100° F.; others consider the tub-bath beneficial in almost any circumstances where the patient's bodily strength admits of the necessary amount of movement. In the case of sick children a tub-bath may, in the majority of circumstances, be safely given, as by careful lifting and carrying they can be saved all exertion.

While the bed-bath may remove as much perceptible dirt as the tub-bath, it has not the same beneficent effect on the system. The skin is one of the most important excretory organs of the body. If not cared for, the pores, which are the openings of the ducts, become blocked with dust and dried perspiration, thereby lessening the functional activity of the skin. The hot tub-bath not only frees the pores of any superficial accumulation, but, dilating the surface blood-vessels, brings more blood to the skin, stimulating the sweat-glands to greater activity, and thus clearing the pores and ridding the body of some of the poisonous products of oxidation.

In giving a tub-bath fill the bath half full of water at a temperature of 100° F., which may be raised to 105° F. after the patient is in. Change the water if it becomes

dirty before the washing is over. Borax, washing-soda, or a small quantity of aqua ammonia may be added to the water if the skin is very dirty or the water hard.

Before beginning, cut the nails close and pin long hair on the top of the head. If it is necessary to wash the hair at the same time, it is better for a woman patient to do so first over a basin. A man or child can have the hair washed conveniently in the tub.

Frequently with ward patients the admission bath is not sufficient to cleanse thoroughly susceptible portions of the body, such as the soles of the feet or the palms of the hands. Where the dirt is ingrained and the epidermis hard and thickened, it is best to soften the skin by enveloping the parts in a soap or flaxseed poultice, if the general condition of the patient permits. The hands may be frequently soaked in hot water and washing-soda and scrubbed with nail-brush and soap. No nurse should feel satisfied until every patient in her charge is spotlessly clean, but she will frequently have to remember to proceed with tact.

After the bath the patient should be thoroughly dried with warm towels, warmly wrapped, and returned quickly to bed. The effect of the bath must be noted, especially such symptoms as shivering, faintness, undue fatigue, or exhaustion. The first may be avoided by having a hot-water bag in readiness in the bed; faintness is relieved by fresh air and lying still without the pillows; while for any signs of exhaustion a glass of hot milk is a good restorative.

To Induce Perspiration (Fig. 8).—For this purpose the bath is filled half full of water at 100° F., and the temperature brought to 110° F. or higher if well borne while the patient is in the bath. Two blankets cover the bath and are pinned together at the patient's neck, thus leaving his head only exposed. The blankets are prevented from sagging by a couple of boards arranged across the bath-tub. Cold sponges or an ice-bag are kept on the patient's head, and the process is helped if, at the same time, he drinks freely either cold water, Vichy, etc., or hot weak tea. The pulse must be taken at the carotid or in front of the ear, and the

patient removed if it becomes soft, compressible, or intermittent. *In all cases where we apply extreme heat in this manner or by similar methods to the body, cold is applied at the same time to the head* in order to prevent what is known familiarly as a "rush of blood to the head," with the symptoms of giddiness and faintness. If faintness should occur, the patient is removed immediately and made to lie flat without pillows. A stimulant, such as aromatic spirits of ammonia (30 minims in water), is frequently ordered for such an emergency.

Fig. 8.—Tub-bath to induce sweating.

From four to seven minutes is usually the length of time ordered for such a sweat-bath. If it is desirable that the sweating should continue, the patient is quickly wiped, wrapped in a hot blanket, and put to bed surrounded with hot-water bottles, covered with several blankets tucked closely, especially round the back, and again induced to drink. The ice-bag is kept on his head. He may be kept thus for an hour, close watch being kept on the pulse. Finally he is rubbed, under a dry blanket, first with hot towels and then with alcohol, and the ordinary clothes, well warmed, replaced. *This final process is observed after all baths that have for their purpose the inducing of perspiration.*

This simple form of bath is ordered when the patient is in sufficiently good bodily condition to be moved from his bed, as in the chronic forms of kidney disease, to break up a cold, etc. In acute illness other methods are used which will be discussed presently.

To Relieve General Convulsions.—For this purpose the patient, usually in a completely unconscious state at the time, lies immersed in the water, his head supported on the left arm of the nurse, while with her right hand she constantly sponges the head with cold water. The water is prepared at 100° F. and brought to 105° F. when the patient has been in the water a few moments. Owing to the unconscious condition of the patient it is not safe to use a higher temperature. Frequently the orders are to keep the patient in the water until the convulsion is over and the body relaxed. At other times the order may be for a bath lasting five to ten minutes, or, rarely, longer, and repeated at intervals. If faintness occurs, evinced by sighing respirations, pallor of the lips, and a pulse becoming soft, compressible, and intermittent, the patient is removed at once and replaced in bed, when the symptoms will usually pass. Stimulants are not generally ordered in these cases.

After the bath the patient is dried, the shirt replaced, and he is put back to bed to rest quietly. If the bath is to be repeated, the shirt may be omitted, and the patient rolled in a light blanket in which he can be carried to the bath, it being an important consideration to carry out the treatment with as little disturbance as possible to the already irritated nerve-centers.

If such a bath is used during an attack of croup or for convulsions caused by teething, the baby is usually kept in the bath until relaxation is complete.

The **hot sitz-bath** is used to relieve local inflammations, such as pelvic cellulitis, or to relax the sphincter of the bladder and so overcome retention of urine. The temperature begins at 100° F., rising gradually as high as can be borne. The patient, sitting in the bath, has the body immersed in water from the upper part of the thighs to the waist. The legs are wrapped in a blanket, and a second

blanket, pinned round the neck, is arranged to cover both bath and patient. The bath lasts ten to twenty minutes, or if for retention of urine, until the condition is relieved.

The **hot foot-bath** is valuable in restoring vitality, in breaking up a cold, in relieving headache, and sometimes as a remedy for insomnia. In the latter cases it acts by drawing the blood from the brain to the extremities, thus inducing a temporary anemia of the brain. The bath is prepared at 100° F., and raised as high as can be borne without faintness. The patient should recline in a chair comfortably wrapped, with a light blanket folded over the legs and bath. If the patient is in bed, the bed-clothes are turned back and the bed protected by a rubber sheet. The bath is placed conveniently, and a light blanket kept over the bath and limbs during the process.

The **tank** or **constant immersion** treatment may be ordered for special cases. At one time it was in vogue for typhoid-fever patients; more generally it is used for cases with large external wounds, such as extensive burns or scalds or large infected bed-sores.

The bath used is a portable, full-sized bath-tub on castors, and should be provided with a stop-cock in order to empty it easily. If it is without a stop-cock, the contents may be siphoned off. To do so, attach a funnel to a piece of uncollapsible rubber tubing, place the funnel in the bath, and lower the other end of the tube over a bucket. Start by filling the tube with water from the funnel end, keeping the lower end pinched until the funnel is inverted in the bath water. A hammock is made of several strips of wide webbing with a ring sewn at either end; these are attached, usually by strong hooks, to the outside of the rim of the bath-tub. If there are no hooks on the tub, a stout cord can be run through the rings and firmly tied under the rim of the tub. The cord must be knotted at each ring to prevent the strips slipping together. The head is supported by a rubber ring cushion, also attached in the same way to the tub. A couple of boards are placed across the tub to prevent the coverings sagging, and the whole is covered with a rubber sheet and

blankets. If the ordinary bed-clothes are added, the tank can look as neat and comfortable as the ordinary bed.

A thermometer must be kept suspended and an even temperature maintained—usually the temperature ordered is from 100° to 102° F. Once a day the patient is moved on to a mattress and the bath emptied, cleaned, rinsed with a disinfectant, and refilled. At this time the daily evacuation of the bowels should take place. If there is no impulse for movement, a soap or glycerin suppository may have the desired result. During this time the wounds are either dusted with sterile boric powder (2 per cent.) or covered with wet sterile gauze. Such treatment is found comfortable and peculiarly satisfactory in cases where large painful daily dressings can be thus avoided, or when it is impossible otherwise to relieve painful parts from constant pressure. A mild antiseptic is usually added to the water, which should, wherever practical, be sterile. Boric acid, about 1 per cent., *i. e.*, about one ounce of the powder for each gallon of water, is generally preferred. A full-sized tub-bath half full usually contains 10 to 15 gallons of water.

Almost the only disadvantage of such treatment is the disturbance unavoidable in moving the patient each time it is necessary to give the bed-pan. In a case of typhoid fever, where a minimum amount of movement is an essential part of the treatment, this is a decided drawback. Where there is loss of control of either bladder or rectum, the tank is not an appropriate treatment.

Local baths, or constant immersion, are also frequently ordered for septic wounds of the limbs. Pans of suitable size and shape are sold for this purpose by surgical instrument-makers, but are expensive, except where they are to be frequently used, as in hospital wards. For a forearm a fish-kettle makes a good substitute, and for a leg a long box, such as is used by florists for flower-stands, may be adapted. The hammocks to support the limbs in a comfortable position are made of strips of webbing two inches wide, each strip with its ends sewn together and made long enough to go round the vessel and dip down into the bath as low as is wanted. The weight of the limb is usually

enough to keep the strips in place; if not, a tape can be knotted at intervals round each strip and tied securely round the rim of the vessel.

The arm bath should be placed on a table beside the bed, and the patient well supported with many pillows; the constrained position is always a tiring one. For a leg bath ingenuity is required to place the bath at a sufficiently low level. It may be placed outside the bed, on high stools, and the patient brought to the edge of the bed; or a mattress in two parts may be used and the lower half removed. The sound limb can be brought to the level of the body by adjusting folded blankets and pillows. Usually boric acid, 1 to 2 per cent. in sterile water, is used, and the temperature maintained at 100° F. The local bath is covered with a rubber sheet and small blanket. The solution is changed every six hours, and once a day the bath should be thoroughly scoured and disinfected. Where it is desired to keep the limb absolutely immovable, the bath must be emptied by siphonage.

The **complete tub-bath of cold water** for the treatment of fever cases was first advocated by a German doctor named Brandt as far back as 1861; the method is, in consequence, often referred to as the *Brandt bath*. Within the last twenty years it has become universally popular, though possibly somewhat less so at the date of writing. It has as its object to reduce the temperature and to relieve the cerebral symptoms. It is also claimed that through stimulation of the circulation the natural processes of metabolism and elimination are increased and the skin stimulated to greater activity. It may frequently be observed that after the bath urine is more freely excreted. Its use is most generally in the treatment of typhoid fever, the mortality of which the use of the Brandt bath is considered greatly to have reduced.

The bath must be given with the minimum amount of disturbance to the patient. A bath-tub on castors, provided usually with stop-cock for emptying, is brought to the bedside, half full of water of the required temperature. Some doctors have the water cold to begin with, others begin at 90° F. and rapidly lower the temperature

to 60° F. by adding lumps of ice after the patient is in the tub. The time ordered is usually five, ten, or fifteen minutes, and the treatment is carried out every three, four, or six hours if the patient's temperature rises above a certain point. Usually a temperature of 102.5° F. or 103° F. is considered an indication for the bath.

The bath in readiness, the patient has a wide towel pinned round the loins and secured between the legs with a safety-pin, and the shirt removed. The limbs and chest should be free of clothing. In hospitals an appropriate stretcher is usually found, made of strips of webbing about three inches wide, attached about three inches apart to a

Fig. 9.—Tub-bath for immersion, and bed arranged for return of patient.

double strip of canvas or stout ticking through which the stretcher poles are run; the stretchers are provided with rings by which they are attached to hooks on the outside of the tub. The stretcher is rolled below the patient in the same way that a sheet is changed, the poles are adjusted, and he is lifted and lowered into the bath on the stretcher.

The bath over, a dry sheet is laid across the bath, the loin towel unpinned under cover and left in the water,

the stretcher raised, the superfluous water allowed for a moment or two to drip away, and the patient lifted back to bed, covered with the dry sheet.

Where there is no such stretcher, a stout hammock makes a good substitute, or the patient may be lifted in his sheet; the sheet, however, must be left in the water after the bath and the patient lifted under the dry sheet by grasping him under the arms, below the pelvis, and by the feet.

While the patient is in the bath a rubber sheet is spread over the bed, from which the upper clothes are removed: a single blanket and a sheet are folded in readiness over the head of the bed. A hot-water bag should be at hand ready filled in case of emergency.

As soon as the patient is placed on the bed the stretcher is rolled from under him and he is wrapped loosely in the dry sheet and gently but thoroughly dabbed until the moisture is absorbed. The sheet and rubber sheet are then removed, and the patient is left wrapped in a light blanket and covered with a sheet until all signs of shivering or chilliness have disappeared, when the shirt is replaced, and the bed arranged in the usual way. If the patient should fall comfortably asleep, he should be left until he wakes without disturbance.

While the patient is in the bath, constant friction with the flat of the hands is applied to the limbs, chest, hips, and shoulders. The pulse must be closely watched. At first, owing to contraction of the superficial arteries from the effect of the cold, the pulse will feel small and hard, and from the nervous shock will probably be increased in rapidity. It should gradually improve, becoming stronger and slower as the treatment is carried out if the bath is having the desired results.

Symptoms that show the bath is having an injurious effect are *cyanosis*, which will be apparent first about the lips, a *weak, soft, intermittent* pulse, and *uncontrollable shivering*. If the doctor is not immediately at hand to take the responsibility of the bath proceeding, the nurse is usually expected to return the patient to bed, to notify the doctor immediately, and not to repeat the bath until

she has had fresh orders. If the baths are to be continued, the doctor should be present at the next one. Untoward symptoms may frequently be averted by the administration of a stimulant immediately before the bath; the dose may also be divided and given half before and half immediately after a bath.

If cyanosis or shivering persist after the bath and the pulse remains feeble and small or intermittent, the patient should be briskly rubbed, two nurses working at the same time, and external heat applied in hot-water bottles arranged at the feet and round the sides of the patient. In some cases it is necessary to place the feet in a hot foot-bath to restore the bodily warmth; generally an order is left for a stimulant to be administered in such an emergency. Cyanosis and shivering sometimes begin after the patient is returned to bed. In these circumstances also the doctor should always be notified, and his orders repeated before the next bath is given.

Before, and immediately after, each bath the temperature, pulse, and respiration are taken and noted in writing. Half an hour after the patient is returned to bed this is repeated and again noted. A drop of over one and one-half degrees is not generally desirable, and should be at once reported. Should the patient be sleeping, usually the taking of the temperature is omitted and a record of pulse and respiration only made. At the same time the temperature to which the water was reduced, the length of time the patient was in the bath, and any symptoms, toward or untoward, that were apparent should be noted accurately in writing.

From the gravity of the condition, the manner in which the cold bath is given in a typhoid-fever case is of special importance. No nurse should undertake the responsibility of giving a bath to an adult typhoid-fever patient alone.

In cases of typhoid fever it is considered of the first importance that in lifting the patient the body should be kept rigid, and that no strain whatever should be thrown on the abdominal muscles. The patient must not exert himself in any way. Sudden exertion, especially that causing any strain or movement of the abdominal muscles,

might cause either serious internal hemorrhage from one of the ulcers, which in typhoid fever develop on the walls of the intestines, or perforation of an ulcer through the intestinal wall into the abdominal cavity.

Hemorrhage and *perforation* are the most dreaded complications of typhoid fever. The first symptoms of the occurrence of either are sudden faintness, pallor, and rapidly increasing pulse-rate and sighing. If the temperature is taken, it is found to have fallen probably below normal. Hemorrhage is further evinced by the passage later of blood-clots from the rectum, or of stools turned a dark tarry color from the presence of altered blood. In perforation the patient generally also complains of acute abdominal pain and has a *rigor* or attack of shivering, the abdomen quickly becomes inflated with gas (a condition known as tympanites) and rigid. Either of these catastrophes might occur as a consequence of giving a Brandt bath carelessly. Should the patient evince any such symptoms during the giving of the bath, he must be promptly replaced in bed, lying flat and motionless without a pillow, and the doctor immediately called. All treatment is, in the mean time, stopped. The patient may be wiped dry without turning and then covered only with one light covering, as bodily warmth would increase the hemorrhage. For the same reason no drink or stimulant must be given. (See also pp. 600 and 610.)

Cold baths are frequently ordered as part of the treatment of *nervous cases*. In ordering such treatment doctors vary greatly in their methods, and all orders should be minutely written down and accurately carried out. Some order one, two, or three plunges in a bath-tub nearly full of cold water, followed by brisk rubbing; in other cases the patient stands with the feet in warm or hot water and the cold water is given as a shower, or emptied from a bucket suddenly over the patient's back. Sea-salt may be ordered to be added to the water, in which case two pounds of Tidman sea-salt should be dissolved in boiling hot water, allowed to cool, and added to a bath-tub half full of water (usually reckoned at 10 gallons). If a salt-water bath is to be taken hot, the sea-salt is added when

the bath is prepared. During the salt-water bath and after the patient's skin should receive brisk friction.

Medicated tub-baths are ordered in some conditions. The temperature of the bath, the quantity of the medicament, the length of time the bath is to be taken, are ordered in each case. Usually the bath is warm enough for comfort, and the patient remains in from fifteen to thirty minutes. The bath-tub must be carefully cleaned and disinfected immediately after use. The bath may be reckoned as 15 gallons of water.

The following are the medicated baths most commonly in use:

Starch Bath.—Mix half a pound of raw starch with cold water and make in the usual way by adding boiling water until thin. Add to the bath-tub. Used in certain skin diseases.

Bran Bath.—Tie one pound of bran securely in a loose bag of thin muslin and place in a large deep basin; fill the basin with boiling water, and set it in a hot place for half an hour. Press the moisture from the bran and add all the fluid to the bath. Used in certain skin diseases.

Alkaline Bath.—Add sufficient bicarbonate of soda to a bath-tub to give a strong alkaline reaction. Test with red litmus paper (p. 237). If litmus paper is not at hand, the bath is sufficiently alkaline when the water has a slippery feeling. Used in skin diseases, to allay itching in irritable eruptions, such as urticaria, and occasionally ordered for cases of subacute rheumatic arthritis.

Sulphur Bath.—Sulphurated potash is used, it being soluble in water. Add to the bath in the proportion of half an ounce to two ounces to the 15-gallon bath. Used in skin diseases and, rarely, for purposes of general stimulation. It must be remembered that sulphur discolors metal substances.

Stimulating Bath.—*Mustard* is usually employed. Tie a quarter pound of table mustard in a muslin bag and place in a basin of cold water; squeeze the bag well and add the water to the bath (15 gallons). Used at a temperature of 100° to 105° F. to restore vitality, especially in infants and young children. The mustard foot-bath

may be used for the same purpose (the same proportions), and is also valuable for breaking up a cold in the early stages.

Turpentine is sometimes employed in the proportion of 4 ounces to 15 gallons of water, as an old-fashioned alleviation in chronic rheumatic affections. Care must be exercised that either mustard or turpentine is thoroughly mixed with the water, or the patient may easily be burnt.

Natural Salts.—Of recent years baths having the same chemical composition as the well-known mineral waters of Nauheim, Carlsbad, etc., and given in conjunction with a strict régime of diet, exercise, and Swedish movements, have become popular in treating certain forms of organic heart disease. The system is known as the Schott system. Bicarbonate of soda, 8 ounces, to dilute hydrochloric acid 4 ounces, is a formula frequently prescribed, but usually the salts are purchased ready prepared under the name of the special spring required. Such baths are, however, usually given in special sanatoria.

After a medicated bath the patient should not be dried briskly, the object being that the skin should absorb as much of the medication as possible. After gentle wiping to remove the superficial moisture clean garments should be put on and the patient made to rest quietly in bed for an hour. In the Schott system the patient is wrapped in a hot clean sheet in order to further the process of absorption.

Tub-bath in Bed.—In cases where the tub-bath is required and the patient unable to be moved from the bed, it may be carried out in the following manner (Fig. 10):

A rubber sheet, half a yard longer and half a yard wider than the mattress, is rolled under the patient (as he lies directly on the rubber, it should be warmed first). Each corner has a ring sewed to it by which it can be tied to the bed-posts: twelve inches from each corner stout tapes are firmly sewn which, when tied in pairs, bring the sides of the sheet as high as the corners. The bath is further given shape by rolled blankets, sand-bags, or pillows placed on each side of the bed outside the rubber. Pillows are also

arranged for the patient's head under the rubber. Two or three boards placed across the bed under the hair mattress prevent too much sagging. Under cover of a light blanket the night-dress is removed and the loin towel pinned securely in place. The bath is then quickly filled from pitchers of water of the exact temperature required.

The water is emptied by lowering one end of the rubber over a bucket; or it may be siphoned off, beginning while the bath is in progress. As about 6 gallons of water are required, such a bath is a lengthy proceeding unless the patient's bed can be wheeled into a bath-room, where the

Fig. 10.—Tub-bath in bed. Extemporized from rubber sheet and pillows.

bath can be filled from a rubber pipe attached to the tap, and again emptied quickly into a fixed slop sink. A special rubber bath-tub supplied with a frame by which the water is kept in a fixed position is also sold for this purpose under the name of the Burr bed-bath, but, like all rubber goods, is expensive.

The bath emptied, the rubber is untied and rolled from beneath the patient, who is dried and dressed in the usual manner. When emptying, the head of the bed should be raised on a chair or couple of blocks, to prevent the water collecting in the middle of the bed.

In cases that have had slight hemorrhages a Brandt

bath may be ordered to be given in this way. The movement necessary is, however, greater than where a tub-bath is given skilfully with a good stretcher.

In many cases of acute illness the tub-bath is impractical and the therapeutic results of the bath must be attained by other methods. The results chiefly aimed at, we have seen, are to induce perspiration, to relax spasms, to reduce temperature, and to allay cerebral symptoms. The methods most frequently employed are as follows:

The Hot Pack.—*First:* Arrange the patient, divested of his shirt, between two hot blankets on a rubber sheet, also warmed.

Second: Wring out of scalding water three light, small-sized blankets *wrung thoroughly dry*, or the patient may be scalded. (For this reason heavy blankets are not practical.) Roll the blankets in a warmed rubber sheet and carry quickly to the patient's bedside.

Third: Place two blankets under the patient (keeping him *closely* covered) lengthwise across the bed, one under the shoulders, one from the waist down; bring the upper blanket round the neck, shoulders, and sides, and roll each arm up; bring up the lower in the same way and roll up each leg and turn the lower margin up over the feet. Place the other blanket over the patient, slipping out the covering blanket, and tuck it round the legs, between the sides, and the already enveloped arms, and over the shoulders very thoroughly, so that no air can penetrate.

Fourth: Bring first the under dry blanket and then the rubber sheet up from either side and tuck firmly under the opposite side; turn up the lower margin over the feet.

Fifth: Replace the covering blanket, tucking it firmly around the mummy-like figure, and cover with the ordinary bed-clothes.

Sixth: In this and all varieties of sweat-baths cold, in the form of the ice-cap or wet compresses, is applied to the head, and unless the patient is unconscious, he is induced to drink freely during the bath. Any hot or cold drink *that does not contain food requiring digestion* is suitable, such as water, Vichy, tea without milk, etc. The

pulse must be frequently taken at the temple, and the patient closely watched for symptoms of exhaustion or faintness.

In cases of acute illness, where immediate action of the skin is imperative, a powerful diuretic, pilocarpin, is frequently ordered to be given at the same time as the sweat-bath. Pilocarpin is the active principle of jaborandi. Usually it is given hypodermically ($\frac{1}{8}$ to $\frac{1}{5}$ grain of pilocarpin hydrochlorid). Five to ten minutes after pilocarpin is given the surface becomes violently flushed, the pulse full and more rapid, and the patient breaks out into profuse perspiration, beginning with the face and neck; the flow of saliva is also greatly increased. This diaphoresis may continue for a considerable time. Pilocarpin depresses the heart and nerve-centers and in rare instances has been known to cause edema of the lungs. Watch must be kept for symptoms of heart failure.

The sweat-bath lasts from twenty minutes to an hour, according to conditions. On removal the patient is rolled without exposure between hot, dry blankets; *when sweating has ceased*, he is rubbed dry with hot towels, and, if desired, also with alcohol, and the ordinary clothes replaced. *No patient should ever be left alone while in a sweat-bath.*

From the practical difficulty of insuring that the blankets are sufficiently hot, and sufficiently dry not to scald the patient, other methods having similar results are preferred to the hot pack. It should be remembered, too, that scalding water ruins a blanket.

The Hot Dry Pack.—Place a rubber sheet and blanket, both hot, under a patient; roll him, divested of his shirt, in the hot blanket; place hot-water cans or bottles, rubber hot-water bags, or hot bricks wrapped in flannel round the patient; cover him with another hot blanket, and above that a second rubber sheet; tuck both firmly in under the mattress and round the neck; cover with as many blankets as may be desired. Apply, as usual, cold to the head, and give drinks freely. The cans, etc., must be carefully covered and arranged *outside the enveloping blanket* in such a manner that the patient cannot come in contact with them or he may be burnt.

In the form of sweat-bath most in use the patient lies

on his bed in what is practically a closed cabinet, his head only exposed; the air in the cabinet is brought to a high temperature by one or other of several methods.

To arrange such a cabinet three rubber sheets, three blankets, and a couple of bed-cradles, each two feet long, are required. If of metal, the cradles should be covered with a closely wound muslin bandage to protect the clothes from rust-marks. The rubber sheets and blankets should be well warmed.

First: Roll one blanket and rubber sheet under the patient, the blanket next him, and cover him with one of his bed blankets; remove the shirt.

Second: Place the cradles so that they extend from the shoulders to beyond the feet.

Third: Tie a bath thermometer to the cradle so that it hangs where it can be easily reached.

Fourth: Bring the lower blanket round the shoulders and neck and up the sides and ends of the cradles as far as they will reach.

Fifth: Cover the cradles with the two remaining blankets placed lengthwise across, and arranging them so that they overlap well. Tuck them securely all round between the under blanket and the rubber sheet. Slip out the blanket covering the patient and tuck in well round his neck and shoulders.

Sixth: Bring up the rubber sheet in the same manner.

Seventh: Cover the cradles in the same way with the two remaining rubber sheets. By this overlapping all cold air is excluded. The reason for placing the blankets before the rubber is that, exposed to dry heat, rubber smells disagreeably, and where steam heat is used, the vapor condenses on the rubber and may drip on the patient. Any number of blankets desired and the ordinary bed-clothes may be added.

The cabinet is heated by hot air, vapor, or dry heat in the following way:

The Hot-air Bath.—A special apparatus is sold for this purpose. It consists of a large alcohol lamp with a metal covering, which is the expanded end of a chimney of convenient shape and sufficiently long to extend just

inside the cabinet at the patient's feet, about six inches above the mattress. The lamp is placed on a stool of convenient height outside the bed. The coverings are opened to admit the end of the chimney and tucked closely round. For this reason the chimney should be covered with an asbestos wrapping, or the bed-clothes may be burned. Where asbestos cannot be had, wet cloths may be wrapped round the chimney and kept damp.

The temperature and the length of time the bath is to last are ordered in each case. Commonly, fifteen to thirty minutes after the required temperature is reached is ordered. The temperature ordered is frequently 120° F.; some patients, however, can stand a temperature even higher. The temperature in all cases must be closely watched and regulated by the thermometer hanging in the cabinet. It must be placed where it can conveniently be reached through a lapping of the coverings, but as far as practical from the stream of hot air.

Where moist heat is desired, a croup kettle is used, the spout being directed inside the covering just above the feet. The croup kettle is a closely covered vessel furnished with a long spout, from which, when the kettle is maintained at boiling-point, a steady stream of steam is emitted. It is placed over a lamp at a convenient height outside the bed; the temperature ordered is generally from 110° to 120° F., the duration the same as for a vapor-bath.

Where steam heat is used, a square of blanket should be laid over the feet below the point where the spout enters. Droppings from the spout have been known to cause scalds. Frequently it is preferred that the whole body should be covered with a single light blanket.

In places where electric light is employed the desired temperature can quickly and very simply be attained by means of an electric drop light tied to one of the cradles and suspended in the center of the cabinet. The candle power should be from 20 to 32. The method was first introduced into the Polyclinic Hospital, Philadelphia, by Dr. Samuel Risley, where it has almost wholly replaced all other forms of sweat-bath, and is now adopted

by several other hospitals. It is simple, quickly prepared, and given with less danger of fire, burns, or scalds than the methods just described. Certain precautions, however, must be borne in mind:

First: If moisture touches the globe, it will burst and the patient may be burnt.

Second: If moisture touches the cord, the insulation is destroyed, a short circuit formed, and the light will not burn.

Third: The heat given out by an electric light is sufficient to set any inflammable substance with which it comes in contact on fire.

Fig. 11.—Cabinet arranged for giving sweat-bath with the electric light (Polyclinic Hospital, Philadelphia).

For these reasons a detachable collar of soft lead is, at the Polyclinic Hospital, wrapped round that part of the apparatus that is to come in contact with the coverings, and a like precaution should always be taken.

Sweat-baths are ordered for cases of nephritis, acute and chronic, for uremia, in some specific conditions, and, more rarely, in the treatment of chronic rheumatism or gout.

The records of such treatment should be kept accurately on the charts, and, where practical, the temperature, pulse, and respiration should be taken and recorded before and immediately after each bath. Where the patient has to

be forcibly restrained, as in the violent convulsions of uremia, the pack is frequently more practical than the other forms of sweat-bath. If the patient is unconscious, it is important to observe whether urine has been voided during the sweat-bath.

Cold Applications.—Where the tub-bath is either not practical or not desired, cold may be applied to the entire body by other methods. The following methods are chiefly employed to reduce temperature, to relieve cerebral conditions, and frequently to induce sleep. As in the case of the cold tub-bath, the process may prove a severe shock to the patient, and he should be closely watched during the entire time. A feeble, intermittent pulse, cyanosis, and shivering are again the symptoms that the bath is not suiting the patient. As in the cold tub, also, the pulse should, after the first shock of cold, become stronger and slower and the cerebral symptoms show marked improvement. Frequently, when the process is over, the patient falls into a natural sleep.

In all cases the temperature, pulse, and respiration are taken immediately before and after the bath, and again in half an hour (unless the patient is asleep), in order to observe the result.

Cold Sponge.—The cold sponge is ordered chiefly to reduce temperature. The temperature of the water is usually from 70° to 60° F. or lower, and the sponging continued for from twenty minutes to half an hour (Fig. 12).

First: Have in readiness a deep basin half full of water at the required temperature, a bath thermometer, a basin of chopped ice, a large wash-cloth, an ice-cap, and a hot-water bag.

Second: Remove the top bed-clothes and shirt, covering the patient with a light single blanket or sheet. Roll under him, above the usual bed-clothes, a rubber sheet large enough to cover the bed. If desired, a sheet may be placed between the rubber and the patient, but is not necessary.

Third: Place the ice-cap on the head and the hot-water bag at the feet.

Fourth: Sponge with a wet sponge in long, single strokes, exposing each limb in turn and the entire chest, dividing the time equally between each. For the last five minutes turn the patient and sponge the back in the same manner. Regulate the temperature of the water by adding ice.

Fifth: Dry by gentle wiping, roll out the rubber sheet, and replace the shirt and covering; or, if desired, the patient may be wrapped in a dry sheet for half an hour before this is done, and the shirt replaced when the temperature is taken. The results on the temperature appear

Fig. 12.—Cold sponge to reduce temperature.

the same in either case. The covering should consist of a single sheet.

Where a closer imitation of a Brandt bath is desired, the sponge is somewhat modified. The body is fully exposed except for the loin cloth; as much water as possible (temperature, 50° to 40° F.) is then taken up in the sponge, which is squeezed over the limbs, chest, and back in turn by one hand, while the other gives brisk friction to the part. The sponging over, the patient is briskly dried with rough towels. The effect desired is the same as when the Brandt bath is used. Unless two nurses can give the bath

at the same time, the process is often found too long and chilling.

The Cold Affusion (Fig. 13).—*First:* Place two long rubber sheets, well overlapping, under the patient, so that the bed is entirely covered; the lower rubber must be of sufficient length that one end can be gathered into a foot-bath placed on the floor.

Second: Place pillows, rolled blankets, or sand-bags on either side and below the head of the patient, *under the rubber sheet,* so that a trough of rubber is formed.

Fig. 13.—Cold affusion to reduce temperature.

Third: Place an ice-bag on his head.

Fourth: Pin, under cover, a loin towel round the patient and remove all the coverings.

Fifth: Raise the head of the bed on blocks about 12 inches.

Sixth: Attach a rubber hose to a tap of cold water and direct the stream over the patient, beginning at the chest; before ending, the patient is turned on his face and the same treatment given. Arranged in this manner, the water will run off the patient into the foot-tub. The

stream should be begun gently. From three to five minutes is usually prescribed. Where no tap is conveniently near, a garden watering-can may be substituted, or water may be siphoned over the patient by a bath hose from a bucket or tank placed a couple of feet above the patient's head.

The cold affusion is not much employed in the course of a long illness associated with high temperature. It is of great value in treating sudden accesses of hyperpyrexia, as in thermic fever, where the temperature may rise to 110° F. and over. In this condition the affusion may be kept up a much longer time, the pulse being closely watched.

The Ice-rub.—The patient, exposed except for the loin towel, is placed on a rubber sheet and the limbs, chest, and back in turn rubbed for from three to five minutes with flat pieces of ice wrapped in gauze. An ice-bag should be kept on the head and a hot-water bag at the feet. This process is sometimes preferred to the cold sponge.

Ice-cradles.—A process known as cradling is sometimes effective in keeping a temperature for hours at a time two or more degrees below that otherwise maintained. Large bed-cradles are placed over the body and covered with a single sheet turned back somewhat at the feet and neck. The night-shirt is rolled up under the arms or removed. From the cradles are suspended several small, uncovered buckets filled with lumps of ice. The buckets must be well made or they will leak unpleasantly; and the ice will require constant renewal. If the patient complains of shivering and discomfort, a hot-water bag may be placed at the feet. An ice-cap is usually applied to the head.

Ice Paddling.—Where better means are not procurable, a temperature may be reduced by inducing the patient to paddle his hands in cold or iced water. A basin half full of water the required temperature is placed on the bed under each hand, and the patient directed to "paddle" the water about. The water should be sufficiently deep that the wrist may be covered. This simple method often has surprising results where the patient is not too ill to make the necessary exertion. In district nursing it is a method that can, with less risk than any other, be carried out in the nurse's absence.

Cold Pack.—The cold pack consists in wrapping a patient in a cold wet sheet, with the object either of reducing temperature or relieving nervous conditions: frequently both results are desired at the same time (Fig. 14).

First: Wring two sheets in cold tap-water and bring them in a basin to the patient's bedside, together with an ice-cap, a cold drink (Vichy, water, etc.), and three single blankets.

Second: Roll the three single blankets under the patient, remove the shirt, covering him with a single sheet.

Fig. 14.—Giving a wet pack.

Third: Roll one wet sheet under him, bring it up over his feet, shoulders, and sides, and fold it over the limbs: cover with the second wet sheet, removing the dry sheet at the same time. Tuck well in round the neck, under the axilla and sides, and between the legs. Every inch of the body should thus be in contact with the wet sheet.

Fourth: Bring the right side of one blanket across the body and tuck it very firmly in on the left side; bring the left side up and tuck it also very firmly in on the right; turn the end over the feet: in this way not an inch of the sheet should be uncovered, the object being to exclude

all air. Do the same with each remaining blanket in turn.

Fifth: Cover with sheet or bed-spread; place the ice-cap on the head and give the patient the drink. Take the pulse at the temple and watch it closely. As a rule, the pack is well borne.

The patient may be left in the pack for an hour, or for longer if, as frequently happens, he falls asleep. After the first shock the sensation induced is pleasant and very soothing. While such a pack has sometimes but little immediate effect on the temperature, the cerebral symptoms, even violent delirium, are usually greatly reduced, and the rest thus procured eventually exerts a good influence on the temperature also. The temperature, pulse, and respiration are, as usual, taken immediately before and after the pack, and again after half an hour's interval. In some nervous conditions, not associated with pyrexia, a cold pack is ordered at bedtime to induce sleep, often with excellent results. It may also be ordered in the treatment of chorea.

When the pack is over, the patient is lightly dried, rubbed briskly with alcohol, and the usual clothes replaced.

Where the first object is the immediate reduction of a high temperature, the pack is given by a somewhat different method:

First: Place the patient, covered with a single sheet, on a large rubber sheet and remove the shirt.

Second: Bring in a basin two sheets wrung out of cold tap-water, place one below and one over him, tucking the sheets in between the legs, arms, and sides.

Third: Have a third sheet in a foot-bath full of *iced* water. Every three minutes change one or other sheet. The upper sheet is usually changed twice as frequently as the lower. Instead of the upper sheet large towels may be used, one for each limb and one for the body, and are changed in turn. Lumps of ice wrapped in gauze or old muslin may be placed in the axilla and round the sides, and the ice-bag is applied to the head. The pack is commonly ordered for from fifteen to twenty minutes. After it is finished the patient is dried, rubbed with alcohol, and the ordinary clothes again replaced.

CHAPTER III

LOCAL APPLICATIONS

Inflammation—Heat and Cold: Cold Compress, Stupe, Ice-bag, Ice-coils—Ice Poultice—Heat—Hot-water Bag—Bran—Salt—Cotton Jacket — Poultices — Stupes—Compresses—Counterirritants—Rubefacients —Sinapism—Cupping—Leeches—Iodin—Ironing—Actual Cautery—Vesicants — Blistering Fluid — Ointment — Flying Blister—Pustulants—Escharotics — Liniments—Plasters—Antiphlogistine.

In the following chapter it is suggested that a lesson be preceded, or directly followed, by a demonstration in which all the varieties of applications mentioned should be viewed and handled by the class, and, where necessary, prepared. During the succeeding weeks the lessons should be constantly practised in the wards, accurate methods closely insisted on, and the effects of the applications employed pointed out.

Local applications to the skin's surface are constantly employed to relieve pain and allay inflammation, to promote absorption of fluids, to overcome certain spasmodic or nervous conditions, and to stimulate the activity of an organ. It seems practical here to give a brief sketch of the cause and process of inflammation, for the relief of which the larger number of the applications to be described are employed.

INFLAMMATION

Inflammation is the local result of some local lesion, which may be due to an injury to the tissues, as in a sprain, a fracture, or a burn, or to bacterial invasion, as in pneumonia, a boil, etc. Inflammation is always described as possessing five classic symptoms: *redness, heat, swelling, pain,* and *interference with function.* In order to understand the effect of local applications on inflammation and their proper use we must understand to some extent the cause and process of inflammation.

The first demand of an injured part is to have a larger supply of blood to repair the ravage. By the action of the vasomotor nerves the blood-vessels of the affected area become dilated, and the rush of blood to the part produces the first two symptoms enumerated above—*redness* and *local* heat. *Swelling* quickly follows as the result of the blocking of the vessels with the oversupply of blood. More is accumulated than can quickly be carried off by the arterioles and capillaries; pressure results, and the fluid portion of the blood is squeezed out of the vessels into the interstices of the tissues. At the same time certain of the white corpuscles, by their independent movements, migrate from the blood-vessels and accumulate in large numbers at the seat of lesion. The smaller blood-vessels are blocked with closely packed red corpuscles.

It will be remembered that the property of many of the white corpuscles is to act as the scavengers of the body; they perform this act by fastening on any foreign body, such as bacteria, inflammatory processes, etc., when they either destroy them by ingestion or carry them to other parts of the body. The white corpuscles that possess this property are called *phagocytes.*

The accumulation of fluid and corpuscles in the tissues causes *swelling*, and consequently *pain*, from the pressure of the swollen parts on the nerve terminations. Pain not the result of inflammation may be present from the beginning as the result of direct injury to the nerves themselves, as in a burn, a fracture, etc.

From these conditions *interference with function* results and is usually easily demonstrated: a swollen hand cannot be used or a swollen eyelid opened. These examples demonstrate only loss of motor power. Interference with the functions of the vital organs of the body is a more serious condition. Inflammation of the lungs cuts off the supply of oxygen from the body. In the kidneys it diminishes the secretion of urine and checks the excretion of urea. Inflammation of any part of the heart deranges the entire circulation, and so on, throughout the whole anatomy.

Under benign conditions inflammation terminates in

what is known as *resolution.* The inflammatory processes and exudations are carried off by the lymphatic circulation, and are partly eliminated from the system by the excreta, and partly absorbed; the swelling subsides, and the circulation resumes its normal course.

Frequently, however, resolution is not attainable. The injury may be so severe that the wounded tissue cannot be revitalized, and forms a foreign body too extensive to be absorbed by the white corpuscles; or the affected area may become invaded with bacteria. A greater number of white corpuscles migrate to the seat of lesion, many of which die, and, together with the injured tissues, break down or *disintegrate* into a thick, greenish-yellow fluid that we know as *pus.* The process by which pus is formed is called *suppuration,* and a local, circumscribed collection of pus is known as an *abscess.*

The cardinal treatment of inflammation consists of absolute rest of the affected part and the local application of cold, heat, or a counterirritant; continuous pressure is also sometimes used, especially in connection with cold applications.

An intelligent understanding of the application of cold and heat will enable one to determine which to apply to the individual case. Both act to some extent as a local anesthetic to the irritated nerve terminations, thus relieving pain. Heat, however, penetrates further than cold, and moist heat further than dry. Cold acts by causing contraction of the peripheral blood-vessels, thus reducing the blood-supply, and by this means lessening the congestion. Heat dilates the blood-vessels and reduces inflammation by enlarging their capacity for an increased blood-supply. It also causes a still greater increase of blood to the parts, with a larger outpouring of white corpuscles, a condition which, as a consequence, also promotes suppuration when continued long. Heat has further the valuable effect of relaxing muscular spasm or rigidity.

In superficial inflammations, where the skin is not denuded, cold is preferred. Where the injury has not involved large areas of tissues, and sudden acute pain bears evidence of wrenched or torn nerves, a profuse

blood-supply is not necessary to repair the damage, and the less exudation there is to absorb, the quicker will the normal condition be reëstablished. A sprain is a typical example of such an injury.

When larger areas of tissues are injured, as in extensive bruises or contused wounds, the nutrition of the tissues is impaired, and, if the blood-supply is lessened or cut off, death of the parts will take place and the tissues slough. Heat applied will minimize the danger by bringing to the seat of lesion a large supply of blood, which will not only help to revitalize the tissues, but, where local death has already occurred, will, by promoting suppuration, hasten the separation of the slough from the living tissues.

In deep-seated inflammation cold is usually ordered where the consequence of an overstimulated circulation are dangerous or distressing, as in conditions of cerebral inflammation and some heart affections; and heat, where pain is a prominent symptom, as in pleurisy or peritonitis, in which latter instance heat also helps to relax muscular rigidity. In some circumstances heat and cold may be used together: for example, in cerebral conditions, such as threatened apoplexy, cold may be applied to the head to reduce the local blood-supply, while heat, applied at the same time to the abdomen or to the lower extremities will, by dilating the blood-vessels in a remote region, still further restrict the circulation of blood in the head. Generally, heat and cold, when used as local applications, are applied directly over the affected area, generously overlapping it.

The action of the third form of local irritation, the counterirritant, is more prompt than either heat or cold. A counterirritant is an application which irritates the peripheral nerves, stimulates the circulation by dilatation of the superficial blood-vessels, and causes, by reflex action, changes in adjacent or in more distant tissues. The effects of a counterirritant are various:

First: Through the stimulation of the circulation the processes of absorption and secretion are hastened.

Second: The dilatation of the superficial blood-vessels relieves congestion and the pain due to pressure, and causes,

by reflex action, contraction of the blood-vessels in more remote regions.

Third: By the dilatation of the lymphatic vessels effusions and inflammatory products are more quickly removed from the seat of lesion.

Fourth: Irritation of the peripheral nerves produces a reflex action by which the sensitiveness of overirritated nerves in other parts is reduced.

A counterirritant may be applied directly over the affected area, or to a part more or less remote, with which it has some nervous communication, either direct or indirect. For example of the latter: acute frontal headache may be relieved by a counterirritant applied at the back of the neck, or cerebral congestion by a mustard poultice applied to the abdomen.

Applied over the heart, a counterirritant acts as a stimulant to that organ in conditions of syncope or collapse. Applied over the epigastrium, it is efficacious in checking nervous vomiting. In this condition the effect is produced in two ways: By stimulation of the circulation in the stomach it increases the natural secretions of the organ, and, secondly, it has a soothing effect, through reflex action, on the overirritated nerve-centers which control the act of vomiting.

APPLICATION OF COLD

MOIST COLD

Cold is applied wet in the form of compresses and stupes.

Ice Compress.—For ice compresses a bowl with a large lump of ice and a small quantity of sterile water is required, and several pieces of lint, gauze, or old, clean muslin, cut the required size. If gauze is used, about six thicknesses are required and the gauze should be folded so that no unraveled edges are left. The compresses are kept in the iced water. In applying they are squeezed nearly dry, and changed before they have time to become warm.

In the majority of cases ice compresses are used for eye affections and applied constantly over the closed

eyelid for many hours at a time. The compress should be cut slightly larger than the eye. Should both eyes be affected, the same compress must not be used for both eyes. In infectious cases each compress must be used only once and discarded; the hand, also, should be protected by a rubber glove and frequently rinsed in a disinfectant solution: boric acid (a 2 per cent. solution) may be ordered in place of sterile water. In operative cases or cases in which there is any wound strict aseptic methods must be observed.

Constant ice compresses are frequently ordered in the early stages of ophthalmia of the new-born. The treatment may be carried out efficiently, and without over-fatigue, in the following manner:

The baby is wrapped in a light blanket so as to pinion the arms, and placed on a pillow on a table. The nurse sits at the table directly behind the infant's head. A piece of rubber sheeting is placed under the head and over the shoulders, to avoid dampening the clothes, and the light is carefully shaded. A basin containing the compresses and one for the soiled pledgets are at hand on the table. In this position a nurse may work for hours comfortably for both herself and the child.

Compresses of a larger size, applied in the same way, may be ordered for the relief of frontal headache and for other local inflammations. Iced water may be used alone or diluted with vinegar, alcohol, or a toilet water that is not too heavily scented, either of which forms an evaporating lotion.

In the treatment of sprains and injuries of like nature, the compress is frequently applied with a firm bandage, which, by constant pressure, assists in preventing the swelling due to exudation. The limb should be raised, and, where practicable, the affected part should be uncovered, except for the dressings. The compress can be kept wet by sopping the bandage frequently. Vinegar, alcohol, a solution of subacetate of lead, or alcohol and subacetate of lead combined, may be used with the iced water, an evaporating lotion causing more intense cold than water alone.

Opium is also used with lead where the pain is severe (lead and laudanum lotion), and chlorid of lime, one ounce to one quart, is useful for its astringent properties. Where the surface has become broken, however, sterile water or a mild antiseptic lotion only can be used.

Ice Stupe.—An ice stupe is a covered compress and may be made of gauze, cotton, or old muslin. It is squeezed until just dry enough not to drip, and covered with a piece of thin rubber sheeting, oiled silk, rubber tissue, or wax paper; any material, in fact, that will keep in the moisture. The cover should overlap the stupe one inch in all directions. It may be kept in position by a bandage, and should be changed before it feels warm. The ice stupe is frequently ordered as a throat application; applied closely round the neck it gives great relief in painful forms of tonsillitis, etc.

DRY COLD

The most common methods of applying dry cold to the surface locally are by the ice-bag or the ice-coil. An ice poultice is also used, but more rarely.

Ice-bag.—An ice-bag is made of rubber or of waterproof material, and may be had in various sizes, suitable for application to the head, the spine, the abdomen, the throat, or the ear. The round, medium-sized ice-bag or cap may, however, be adjusted to most uses. When an ice-bag is not procurable, one may be improvised from the bladder of a sheep, taking care to tie the opening securely. In filling an ice-bag it should be remembered that the less the amount of air admitted into the bag, the longer the ice will last. When filled, the bag should be gathered closely in one hand to press out the air while the top is adjusted. For the same reason water should be emptied out of the bag as soon as it forms. Small lumps of ice without sharp edges are used to fill the bag unless the patient has to rest or lie upon it, when crushed ice only must be used and the bag not more than half filled; in this circumstance it will require to be very frequently replenished. In many instances the weight of the ice-bag cannot be borne and should then be suspended so that it just touches the surface of the affected part. An

ice-bag for a limb or the abdomen may be hung from a bed-cradle, or for the head from the railing of the bedstead. When it is desired to keep the ice-bag closely on one spot (as over a special area of the lung in pneumonia), it may be kept in place by two turns of a bandage round the body, and can be removed for filling without undoing the bandage. An ice-bag should be used with a slip-cover of muslin or Canton flannel, or, failing these, should be wrapped in a clean towel. Except when applied over the hair, a fold of lint or flannel should be placed between the bag and the bare skin, to prevent the risk of freezing small portions of the surface.

An ice-bag applied to the head is a common means of relieving cerebral congestion or of reducing the general temperature of the body. Placed over the epigastrium, it may allay persistent vomiting, and over the abdomen may also be used to reduce temperature. It is a valuable application to all forms of local inflammation where cold treatment is indicated.

After use the ice-bag must be carefully dried and packed, until again required, with sufficient cotton or gauze to keep the surfaces apart.

Ice-coils.—An ice-coil consists of a coil of rubber tubing (Fig. 15) through which iced water can be kept continually flowing. It can be laid over an affected area, and from its lightness is usually an acceptable application to the patient. It is most frequently used over the abdomen, either for local application or to reduce the general bodily temperature, but it may be applied to any part free from pressure. Obviously, the water will not flow if the tubes are compressed from the patient lying on any part of them.

A special coil is sold under the name of *Leiter's coils.* Fine rubber tubing is used, coiled round and round from the center, and kept in place by double pieces of webbing radiating from the center and sewn together between each coil. It has the appearance of a large solid spider's web. The center portion only of the tubing is coiled, a free length at either end communicating, the one with a tank or bucket containing water and ice, placed a couple of

feet higher than the patient, the other with a bucket on the floor. A funnel covered with gauze to prevent impurities from the ice from entering the tube is attached to the upper length of tubing and inverted in the tank of water. The upper tube should also be fitted with a U-shaped connecting tube of glass or hard rubber, placed over the edge of the tank, as the soft tubing will become compressed against the sharp edge. By loosely knotting the tubing the flow may be regulated. It is sufficient if the water just trickles through. The temperature of the water is regulated by lumps of ice. To start the water flowing it is

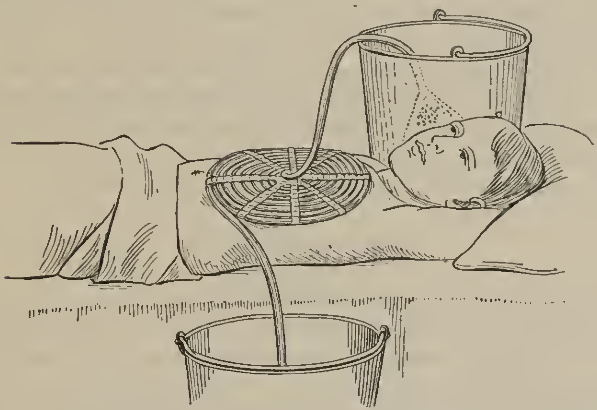


Fig. 15.—Application of the cold-water coil to the chest in croupous pneumonia or pleurisy. Leiter coil.

generally necessary to run water through the coil from a pitcher; when running freely, the lower end of the tubing is pinched and the funnel placed in the tank. Once started, the flow will continue, unless the tube becomes blocked. When the upper bucket is nearly empty, the buckets can change places, and the same water, with the addition of fresh ice, be used again.

Small coils, for application to the ear, etc., or for children can be easily contrived. Fine rubber tubing should be used and should be coiled in the manner described on a piece of firm muslin. Each coil can be kept in place by a few loose stitches over the tubing. While making the

coil, the "web" should be laid flat on a table in order to avoid twisting the rubber. A piece of lint or flannel should also be placed between the coils and the surface of the skin in applying.

Ice Poultice.—An ice poultice consists of small pieces of ice freely mixed with flaxseed meal or with bran. Salt is frequently added, and gives a more intense cold. The mixture is spread between two pieces of gutta-percha tissue, the lower of which is cut two inches larger than the upper. The edges of the lower are folded over the upper, and the two pieces sealed together with chloroform or turpentine, or by passing quickly over the edges a lighted match.

The ice poultice is not so frequently used as other cold applications, but it may be a valuable substitute when little ice can be had, and is sometimes preferred as an application for bruises about the face and eyes, or in ear affections, especially among country practitioners.

HOT APPLICATIONS

DRY HEAT

The Hot-water Bag.—Familiar as are its uses, simple as it is to handle intelligently, probably more than one-half the accidents in nursing are caused by careless use of the hot-water bag. Patients are either scalded by the bag bursting, or burnt by prolonged contact with the bag while in an unconscious or helpless condition. More than one hospital has been heavily fined and subjected to expensive litigation by just such an accident, an accident that the simplest intelligent care should make impossible of occurrence. It is hardly too much to say that in nursing the abuses overbalance the usefulness of the hot-water bag.

The employment of the hot-water bag should be covered by strict rules with which each nurse should be made personally acquainted. The following are suggested by experience.

First: The water used must not be hot enough to scald should the rubber burst; boiling-hot water will also injure the rubber.

Second: The bag must not be more than half full, and the superfluous air must be pressed out before the screw top is adjusted.

Third: Every bag must have a covering, and never, on any pretext, be given to a patient without it.

Fourth: If ordered for an unconscious patient, a blanket or sheet must intervene between the body of the patient and the covered hot-water bag. No one but one of the nurses (*i. e.*, neither another patient nor a friend), may place it in position; wherever practical it should be a rule that a second nurse is called to overlook the proceeding and pronounce that the bags are in proper position.

Fifth: A hot-water bag must never be left in the bed with an ether patient unless by a special *written* order of the doctor, covering the particular case. If such an order has been given, the bags are placed as for an unconscious patient, and the patient must not be left alone one moment, however urgent the pretext, as long as the bags are in the bed.

The reason for such a stringent rule as the last is that an ether patient is usually restless, and it is impossible to place the bags where he cannot reach them. In the restless stage he is in a semiconscious condition only, and the hot-water bag may easily rest long enough against his flesh to cause a deep burn without his being aware of the fact. There are instances where a patient has been kept in a hospital many weeks after complete recovery from his operation owing to burns received while recovering from ether. That he should bring a suit for damages against an institution in these circumstances is not surprising.

The hot-water bag is used for restoring the general bodily warmth in conditions of lowered vitality (several bags being placed round the body and at the feet), for the relief of local pain and inflammation, and to counteract the depressing effect on the circulation of cold applied to the body generally, as in packing, sponging, etc. When used as a stimulant to the general circulation, it is best placed at the feet. It is applied to the perineum or over the bladder to overcome retention of urine.

For restoring the bodily warmth the hot-water bag can be adequately replaced by bricks or soapstone made hot in the oven and protected by a flannel cover, or by cans or bottles filled with hot water. The same precautions must be observed in their use.

Bran Bag. Salt Bag.—Small pillows made of flannel and filled with bran or salt may be made hot in an oven and used as a soothing application, especially in neuralgic pain of the face, toothache, or earache. They retain heat for a considerable time. A second bag should be kept in the oven to replace the other when it begins to cool.

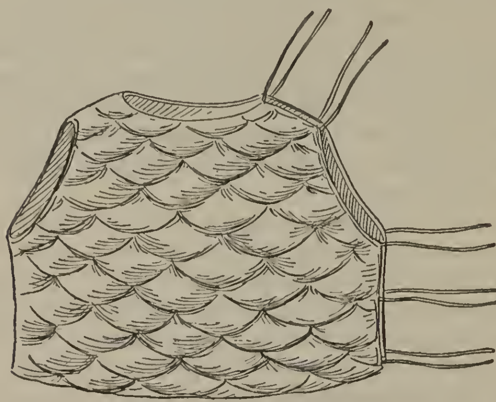


Fig. 16.—Pneumonia jacket.

Cotton Jacket.—Raw cotton, heated at the open fire or over hot-water pipes, retains the heat for a long time, and applied with a flannel bandage affords a grateful application for faceache, earache, painful glands, etc. Sewed into a "cotton" or "pneumonia jacket" (Fig. 16), it is often used as a matter of routine treatment in cases of pneumonia, especially if poultices or stupes have been previously applied. The pneumonia jacket is made of cotton, between two layers of gauze or thin muslin, cut to fit closely to the body, with arm-holes and shoulderpieces so as completely to cover the thorax. One side is left open and is fastened by tapes under the arm and over the shoulder. The

jacket is usually lightly quilted to keep the cotton in place (Fig. 16).

When it is desirable to wash the jacket, it should be put into a tub of suds, not too hot, and kneaded, never rubbed; it should be rinsed thoroughly, and the water squeezed out between the hands instead of wrung, well shaken, and quickly dried.

In cases of pneumonia the value of a cotton jacket is especially in protecting the skin surface from chilling, due to changes of temperature.

Thermostat.—A patent invention consisting of a rubber bag (in various sizes) containing some substances which, by a chemical process, engender heat when the bag is lightly rubbed up, is on the market as a substitute for either of the above. It is claimed that in these bags heat can be retained at a high temperature for hours and even days at a time. The invention, known as a *thermostat*, is hardly as yet perfected.

MOIST HEAT

Poultices.—A poultice or *cataplasm* may be made of any substance which, when parboiled, is capable of holding heat and moisture. The most satisfactory poultice is made of flaxseed (linseed) meal, which, on account of the oil it contains, retains heat for a longer period than such substances as bread, etc. If the flaxseed meal is mixed with from one-half to one-third the quantity of bran, an equally satisfactory poultice is achieved at less cost.

In making a poultice the water must be boiling, the basin, etc., used heated before beginning, and all required at hand, so that the poultice may not cool during the preparation.

Poultices may be spread on old muslin, linen, lint, absorbent cotton (extravagant except for fingers, ears, and other minute portions), or tow, smoothly pulled into strands which readily hold together. The latter is light, inexpensive, and is especially useful where the poultice is applied over discharging wounds, as free drainage is not impeded. The material used is prepared two inches larger than the required poultice, to allow for turning in the margins. The poultice bowl should be kept entirely

Figs. 17 and 18.—Making a poultice.

for such a use, together with a spatula or flexible knife for spreading the poultice.

Sufficient *boiling* water is poured into a heated basin and the meal run in quickly through the fingers of the left hand, the right hand stirring all the time with the spatula. When the mixture is cohesive and will come clean from the side of the basin or drop clean from the spatula, it is of the right consistency. It is then turned on to the muslin or tow, which has been prepared on a flat board, such as a pastry board, and evenly spread with the spatula, dipping the spatula in boiling water once or twice during the process. The margins are turned tidily in all round and the poultice rolled up in a warm towel and carried to the patient (Figs. 17, 18). Before applying it the nurse should hold it against her own cheek to insure its not being too hot. If it is gradually applied to the patient's skin, a higher temperature can be borne than if placed, all at once, quickly over the surface.

A poultice that does not contain an ingredient irritating to the skin should be applied directly to the skin surface; it is not correct to cover it first with thin muslin or gauze, which absorbs the moisture and soon becomes wet and uncomfortable. In order to retain the heat and moisture the poultice, when in place, is covered with a piece of thin rubber sheeting (the rubber side next to the poultice) overlapping the poultice one inch each way, and again with a layer of cotton overlapping the rubber covering. It is kept in its place with a binder or a bandage (see Bandages, Chap. VIII). For application to the extremities, etc., poultices may be spread half an inch thick or more; a chest poultice should not be more than a quarter of an inch thick, while those for the abdomen or tender surfaces should be spread as lightly as possible—not more than an eighth of an inch thick.

Except over wounds, a poultice should not remain on over an hour, and should be removed even sooner if the heat is not retained. A cold poultice is uncomfortable and inefficacious. On removal, the surface is dried and covered with a layer of well-warmed absorbent cotton, which is left on until the next poultice is applied, usually at regular intervals of two, three, or four hours, according to circumstances. If the skin is red,—and it

must always be carefully inspected,—an application of sweet oil or vaselin is made, and if another poultice is necessary, the poultice itself should have a little sweet oil spread over its entire surface. The redness should be reported, and no further poultice applied without fresh orders.

As a treatment in pneumonia, especially in the lobular pneumonia of children, poulticing is still popular with some doctors, though not nearly so common as fifteen or twenty years ago. If continuous treatment is required, it is usual to apply the poultices alternately to the front and back of the chest.

To a *flaxseed poultice* a further counterirritant effect may be given by the addition of mustard.

Preparing the poultice in the usual way, mustard flour, broken free of lumps, may be stirred into the poultice just before it is spread: the proportion of mustard may be from one-tenth to one-sixth of the whole. The active principle of mustard is a volatile oil, the properties of which are, to a great extent, destroyed by boiling water. A poultice containing mustard should have the surface covered with a thin piece of muslin, otherwise there is a risk of particles of mustard adhering to the skin and causing burns or intense irritation. It should be removed as soon as the skin is reddened, a corner of the application being raised from time to time to ascertain the condition. From fifteen minutes to half an hour is the average time such a poultice is retained, unless the proportion of mustard is very small.

A *soothing* or *anodyne* property may also be given to the flaxseed poultice by sprinkling over the surface one dram of tincture of opium, or spreading the surface of the poultice with a thin layer of glycerin and belladonna (official). Neither should be used over a broken surface. Although the absorbent power of the unbroken skin is not great, if such a poultice is used, the patient must be watched for symptoms that would indicate too free absorption of the drug. The absorbing property of the skin is considerably raised by the moist heat of the application.

One of the actions of moist heat being to encourage

suppuration, the poultice may be used to hasten the separation of foul-smelling sloughs or gangrenous tissues from wounds. The flaxseed poultice is usually used frequently mixed with one-sixth part of powdered wood-charcoal, which acts as a deodorizer. The charcoal is stirred in just before spreading and well mixed. A charcoal poultice is applied directly to the surface of the wound without the covering of muslin necessary in a mustard poultice. At the present day poulticing is not a common treatment for wounds.

Oatmeal, wheatmeal, ground corn, and such vegetables as carrots, peas, beans, etc., may be used to make poultices where flaxseed is not procurable. They should be cooked until soft and all superfluous moisture then drained away, when they can be spread the required thickness and applied. Being more apt to stick to the skin than flaxseed, the surface of the poultice should be spread with warm sweet oil and covered with a layer of thin muslin. If an onion is used, it is boiled until it falls apart, or cut into slices, fried, and applied while hot.

A *bread poultice* is prepared by placing a thick slice of bread on a board or over a sieve, and pouring on it boiling water until it is sufficiently soft. The board is held so that the water can run off into a basin or sink. The bread is then spread on muslin and applied, usually directly to the surface. This is entirely a domestic remedy and not greatly efficacious. It is a favorite method of drawing splinters from fingers.

Soap Poultice.—A soap poultice is used for its cleansing effects. It may be applied to portions of the body difficult to cleanse, such as the heels, palms of the hands, or the umbilicus; or to soften and remove the crusts of ringworm or scabs of neglected wounds. It should not be used to remove scabs due to skin diseases other than ringworm. A piece of clean, soft old muslin is soaked in tincture of green soap (warmed) and applied directly to the part. The poultice is covered with gutta-percha tissue, etc., cut to overlap an inch in all directions, and kept in place with a bandage. It should be changed before becoming dry, but usually it is sufficient to change the

poultice night and morning until the desired result is attained.

Oil Poultice.—Muslin or gauze soaked in warm sweet oil may be used instead of the soap poultice, for the same purposes, and applied in the same manner.

Starch Poultice.—A starch poultice is made of laundry starch cooked in the usual way, *i. e.*, mixed to a paste with cold water, and sufficient boiling water added to bring it to the required consistence. It is spread about half an inch thick between two folds of muslin and covered, like the soap poultice, with some protective when in place. It may be applied hot or just warm, according to circumstances. It is ordered in some skin affections for removing scabs and crusts and to allay itching. It is applied directly to the part.

Poultice of Digitalis Leaves.—A poultice of dried digitalis (foxglove) leaves is sometimes ordered in cases of nephritis, applied over the loins to stimulate the activity of the kidneys. To the leaves sufficient hot water is added to barely cover them, and they are allowed to simmer gently until soft enough to break into pulp. The pulp may be spread between two folds of muslin and applied to the surface, or may be incorporated with a flaxseed poultice in the same manner as mustard or charcoal. The water in which they are cooked should be used in mixing the poultice.

Stupes or Fomentations.—A stupe or fomentation affords a clean, economical, and efficient method of applying local heat. It consists of two or more layers of soft old flannel or blanket wrung as dry as possible out of boiling water, applied directly to the skin, and covered, to retain the heat and moisture, with a piece of light rubber sheeting at least an inch larger in each direction than the stupe, and again with a pad of absorbent cotton; the whole kept in its place by a binder or bandage.

To prepare, a wringer and a fairly deep basin are required (Figs. 19, 20). The wringer is best made of one and one-half yards of stout roller toweling, the ends sewn together. This forms a double wringer three-quarters of a yard long. It is laid open in a well-warmed basin, the

ends hanging over the sides; on it, at the bottom of the basin, is placed, folded, the dry flannel. *Boiling* water is then poured on, the sides of the wringer are folded over the

Figs. 19 and 20.—Preparing a stupe.

flannel, and the ends grasped and twisted firmly in opposite directions until all the water is wrung out of the stupe. If managed with any care, the ends are easily kept dry, and the stupe sticks, so often advocated, are not necessary.

If the stupe has to be carried any distance, it should be wrung out at the bedside, as it rapidly cools. Great care must be taken that the stupe is wrung really dry, if not, the patient may be scalded. It should be shaken a moment or two in the air before applying, to let the steam escape.

Where a stupe is ordered over a broken surface, sterile gauze instead of flannel is used, and a sterile towel may serve as a wringer. An antiseptic solution is often preferred to the plain boiling water. Such a stupe is a surgical dressing, and the same strict asepsis must be observed in applying it as in any other variety of dressing.

Stupe as a Counterirritant.—Turpentine sprinkled over the stupe is a common form of the mild counterirritant. One to two drams of household turpentine (measured) is freely sprinkled over the *dry* flannel on the surface which is to be next the patient. The flannel is then folded and the stupe prepared in the usual way. In sprinkling before the water is added there is less risk of the turpentine collecting in one or two spots, an accident which may cause a troublesome burn. The turpentine stupe is frequently used for the relief of intestinal distention. It is useless in the true abdominal tympanites of peritonitis except to soothe pain.

Sedative Stupe.—Tincture of opium, belladonna, or infusions of poppy heads are sometimes added to the stupe when it is used for the relief of acute local pain, such as over painful glands or for earache, where the skin surface is unbroken. Tincture of opium, one to two drams, is freely sprinkled on the prepared stupe *immediately before applying*. By this method none of the drug is lost in the water used for the stupe.

Belladonna and glycerin (the official preparation) is spread thickly over the flannel before the water is added. A second method is to spread the belladonna and glycerin on a piece of lint, apply it first to the part, and over it a plain stupe.

Medicated stupes are prepared by using an infusion of a raw substance containing a drug in the place of plain boiling water. Digitalis leaves and the heads of the white poppy, from which opium is obtained, may be used in this way.

Digitalis Stupe.—To the dried leaves is added sufficient boiling water to cover them, they are kept simmering until soft, then broken up with a fork and allowed to cool. When cool, the fluid is strained, heated to scalding point, but not boiled, and used for the stupe. It is used for the same purpose as the digitalis poultice.

Poppy-head Stupe.—To two dried poppy heads is added a pint of boiling water. The capsule should be freely slit with a sharp knife before adding the water. The heads should simmer until soft, then stand until cool, when the fluid is strained, heated to scalding point, and used for the stupe. It is employed, though not very commonly, to relieve the pain of earache, neuralgia, or enlarged glands.

Alkaline Stupe.—Sufficient washing-soda (or bicarbonate of soda) may be added to the stupe water to give it a strong alkaline reaction, and the stupe is prepared in the usual manner. The alkaline stupe is a homely remedy for painful joints in chronic and subacute rheumatism, and often appears to give great relief. When no litmus paper is at hand to test the reaction, sufficient soda to give the water a slippery feeling is the indication.

When a poultice or stupe is discontinued, the part should be covered for a time with a piece of absorbent cotton or flannel.

HOT COMPRESSES

Hot compresses are frequently ordered as an eye application, especially in inflammatory conditions caused by wounds from foreign bodies. Except that the compresses are wrung out of hot water, they are applied in the same way as cold compresses. The water may be kept at a correct temperature by placing the basin over an alcohol lamp, Bunsen burner, or electric heater. The compresses are applied as dry as possible and as hot as can be borne without scalding the eyelids. The hand should be protected by a rubber glove, or a wringer may be made of a small piece of sterile muslin, to each end of which a pair of artery forceps is clipped; by twisting these in opposite directions, the compress is efficiently wrung. The appli-

cation is frequently ordered for from ten to twenty minutes at regularly repeated intervals. Between the intervals the lids may be smeared with sterile vaselin or albolene.

COUNTERIRRITANTS

Counterirritants are divided into *rubefacients*, those that redden the skin surface; *vesicants* or *epispastics*, those that produce a blister or exudation of serum between the cuticle and the dermis; and *escharotics*, those that destroy the soft tissues and cause sloughing. A vesicant that, instead of a clear blister, causes a pustule or milky exudate is also called a *pustulant*. A pustule contains serum and white corpuscles, takes longer to heal, and is more liable to cause a scar than the clear blister, which heals quickly and leaves no scar.

RUBEFACIENTS

Heat.—Heat in many of the applications mentioned above may also correctly be considered as a rubefacient; this is especially the case where it is employed in combination with a counterirritant, as in the mustard poultice or the turpentine stupe, both of which are, properly speaking, counterirritants and in common use.

Sinapisms or Plasters of Mustard.—*Mustard Paste.*—A paste is made of flour and warm water, into which is stirred a proportion of dry mustard, broken free of lumps. The proportion of mustard varies from an eighth to a half. The half-in-half paste is used when only one application is desired, as, for instance, when applied to the chest to help in breaking up a bronchial "cold." The usual proportion is one part of mustard in four of flour for an adult, and in from six to ten parts of flour for a young child. The paste is spread on thick muslin and the edges turned over; the surface next the skin is covered with gauze or thin muslin. It may be left on for from five minutes to a quarter of an hour, a corner being raised from time to time to watch the results, and the sinapism removed as soon as the skin is well reddened. If the skin is easily affected, as in children, the white of one egg may be mixed with the paste or a little sweet oil spread over the surface.

It must be remembered that mustard is not a counterirritant in the dry form. Its active principle or irritating property is contained in a volatile oil set free only on the addition of water. This is easily demonstrated by smelling mustard before and after water is added. Where very hot or boiling water is used, much of the active property is destroyed, as also where vinegar is used to mix it, as in "French mustard."

An official preparation known as the *mustard-leaf* is a simple method of using mustard as a counterirritant. Cut to the required size, the leaf is dipped in tepid water, allowed to drip for a moment or two, and applied directly to the skin surface, or, if the skin is delicate, with a layer of thin muslin between. It cannot usually be borne more than for from four to eight minutes.

After the removal of a mustard paste or mustard-leaf, warm, dry cotton or a soft handkerchief should be kept on the part until the redness has disappeared. If deeply reddened, an application of sweet oil or vaselin may be made. A sinapism should not be left on long enough to cause a blister.

Spice Poultice.—This is a form of mild counterirritant not met with in modern nursing, but still used among old-fashioned people to relieve the pain of muscular rheumatism, especially lumbago. The poultice is made of one-half the quantity of flour, the other half of equal parts of various spices, cloves, allspice, ginger, cinnamon (powdered), with a smaller proportion of either capsicum or Cayenne pepper. The flour is first made into a paste with hot water, the spices stirred in, and the Cayenne pepper or capsicum sprinkled over the surface. The poultice is spread on muslin and the surface covered with gauze. It may be kept on as long as comfortable.

Dry Cupping.—For cupping, a set of glass cups, five to seven in number, are used. Special rimmed cups of thick glass with a capacity of from one to four ounces are used, but any glass of convenient size may be substituted. The inside of the cup is rubbed over with a little cotton sponge soaked in alcohol, the sponge conveniently mounted on a small applicator; to the cup a light is then

applied, the alcohol flames up, and in so doing exhausts entirely the air in the cup. The rim of the cup should be wet with water to prevent it becoming so hot as to burn the skin. Just before the flame dies out the cup is quickly inverted over the affected area, to which it will readily adhere. The skin and tissues covered by the cup are drawn up into the vacuum, the superficial blood-vessels become greatly dilated, bringing an increased quantity of blood to the surface. Five to seven cups are usually applied at one time, and left in place until the skin is well reddened. To remove a cup, the tip of the finger is inserted under the rim; air being then admitted, the cup is no longer adherent (Figs. 21–24).

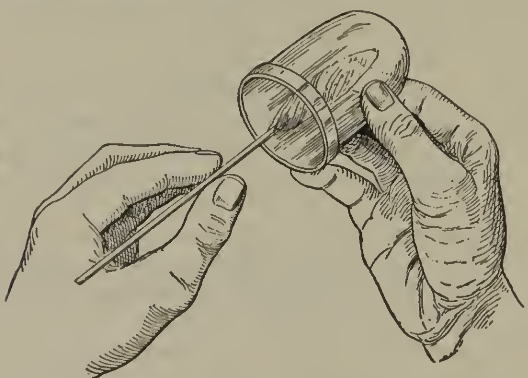


Fig. 21.—Cupping. First step, swabbing the interior of the cupping glass with alcohol (Morrow).

Wet Cupping.—If, before the application of the cups, several incisions with a sharp knife are made over each space, blood will be drawn from the tissues into the vacuum when the cups are in place. The process is known as wet cupping. The skin should previously be scrubbed with sterile soap and water (shaving if necessary) and washed with bichlorid of mercury. On account of their inflammable qualities neither alcohol nor ether should be used in the preparation of the skin, as if not entirely removed, the skin may be burned. On removal of the cups the parts are covered with a sterile dressing, the blood with-

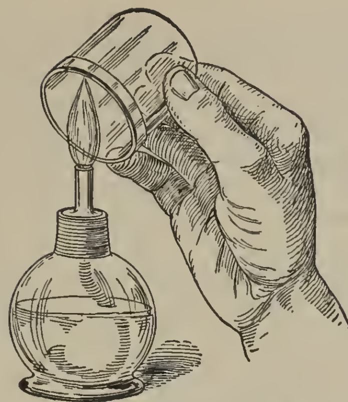


Fig. 22.—Cupping. Second step, igniting the alcohol in the cupping glass (Morrow).

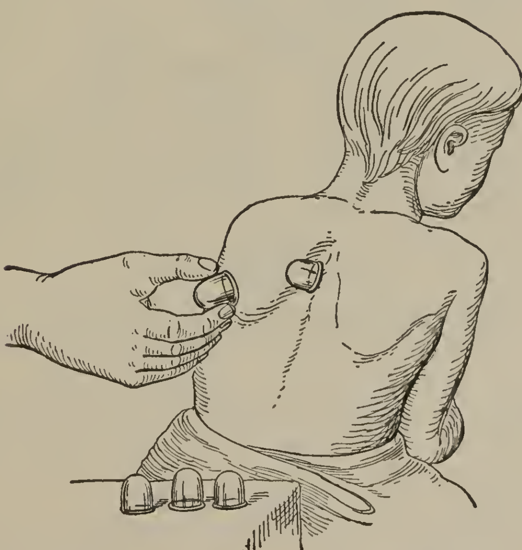


Fig. 23.—Cupping. Third step, the application of the cups (Morrow).

drawn carefully measured, and note made of the quantity.

Cupping is used chiefly in the treatment of pneumonia, acute nephritis, or edema of the lungs, to which end the cups are best placed on the flat surface of the back or loins. Wet cupping may also be used in the treatment of inflammatory conditions of the eye or ear, small-sized glasses being applied over the temple or behind the ear. Where they can be procured, leeches are, however, preferred.

Leeching.—While not a rubefacient, leeching may conveniently be considered in this group. The leech, or *hirudo,* is a blood-sucking worm found in the ponds and marshlands of special districts. Those used in medicine

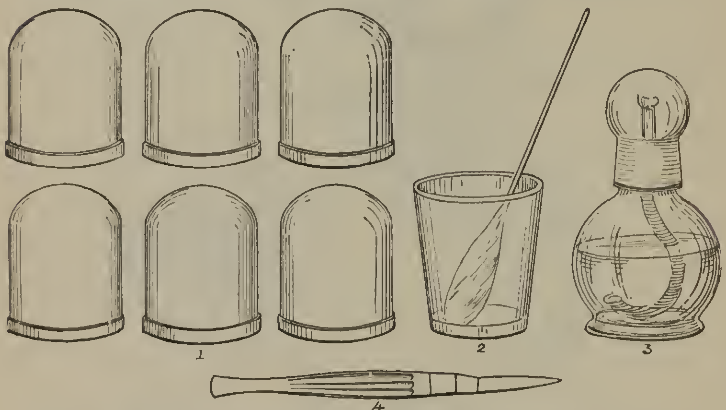


Fig. 24.—Instruments for wet cupping: 1, Cupping glasses; 2, swab in alcohol; 3, alcohol lamp; 4, scalpel (Morrow).

usually come from Sweden, those native to America being considered to have only one-sixth the strength of the Swedish leech. Until ready for use they should be kept in a jar of clean fresh water, with some sand at the bottom, closely covered with a perforated top.

As a leech-bite is liable to bleed, care must be taken to apply the leech to such parts as can readily have pressure applied to them. The temple or forehead, and not the eyelids, for example, is used in applying leeches to relieve inflammatory conditions of the eye.

The skin is prepared by washing with *unscented* soap,

rinsing thoroughly with water, and drying with sterile cotton. If necessary, as behind the ear, the part must be shaved. Disinfectants or applications with an odor will prevent the leech biting. The leech may be held in a piece of gauze, but usually will bite more quickly if placed in a test-tube which is inverted over the spot. Care must be taken to apply the head, and not the tail of the animal. The head is recognized by the three-cornered or **Y**-shaped mouth peculiar to the leech.

If the leech does not bite, he is usually hot, uncomfortable and irritable, probably from having been kept out of water. He may be coaxed by smearing the part with milk, or by pricking the part until a drop of blood comes, or by gently stroking his back, but if still obstinate, it is quicker eventually to return him for a time to the water, and allow him to cool himself off in a dark place. A leech will frequently refuse to bite if the atmosphere of the room is heavy with tobacco or disinfectants, etc.

The Swedish leech will draw from half an ounce to an ounce of blood, the American about a sixth as much. When full, he will drop off, and is then usually destroyed by covering him with salt and burned. He should not be thrown alive down the soil-pipe. If it is desired to remove a leech while sucking, he is sprinkled with a little table-salt. He should never be pulled off, as the teeth are then liable to be left, causing hemorrhage, slight but difficult to control, and subsequent inflammation. After removal, if there is no hemorrhage, a minute dressing of gauze and collodion (p. 489) is applied. If there is any tendency to bleed, a dry graduated compress (p. 584) may be tightly bandaged over the part, and if obstinate, ice compresses or some styptic such as alum, tannic acid, etc., is also applied. Occasionally a further quantity of blood is withdrawn by applying poultices to the bite after the leech is removed. A patient to whom a leech is applied should not be left alone. If, for any reason, this is inevitable, the ears and nostrils should be plugged with absorbent cotton in case of the leech straying.

Many patients object to the sensation of the leech's body; this can be obviated by placing a fold of gauze or

handkerchief under the leech once he is seen to be holding firmly.

Leeches are most commonly employed in inflammatory conditions of the eye or ear, and are applied to the temple, forehead, or behind the ear. They are also, though not so frequently, applied behind the ear to relieve cerebral congestion, and over the pericardium in the treatment of acute pericarditis. In gynecologic work they are sometimes applied to the cervix uteri; this is, however, never left to the nurse.

Tincture of Iodin.—Tincture of iodin, painted on the skin surface, is used as a mild counterirritant in many conditions, especially those in which it is desirable to check the formation of effusions, as in pleurisy or inflammation of a synovial membrane. It is also generally used in the treatment of enlarged glands. It is of little value for the relief of acute pain.

The amount required for one application is poured in a small saucer and painted quickly (it evaporates on standing) on the surface with a camel's-hair brush, care being taken not to allow the application to run beyond the specified area. If necessary, this can be prevented by previously outlining the space with sweet oil or vaselin. A light application stains the skin yellow; usually the iodin is applied until a mahogany hue is reached. Each layer should be dry before the next is applied. It should not be applied sufficiently thickly to cause a blister. For the same reason the surface should be painted evenly—not too thickly on one spot. Usually the application is made two or three times at intervals of twenty-four hours. If a mistake has been made and too much applied, it can be removed with alcohol.

The painted area should be covered with a piece of muslin or a bandage to protect the linen from staining. If a stain occurs, it should be removed before washing by covering with a paste made of raw starch and alcohol.

Ironing.—Ironing the surface as a remedy for pain, especially that of muscular rheumatism, is not often ordered in hospital work, but is a common remedy in home nursing.

The painful surface is covered with a piece of thick paper, just above which a hot laundry iron is repeatedly passed until the skin is reddened. The iron must not be pressed down on the paper.

The Actual Cautery.—Cauterization, or the searing of the flesh, is a form of counterirritant which may be rubefacient, vesicant, or escharotic, according to the degree employed.

The instrument generally used in medical practice is the *Paquelin cautery*, though a metal, such as iron or steel, capable of sustaining a high degree of heat, may be substituted in any practical form. The Paquelin cautery

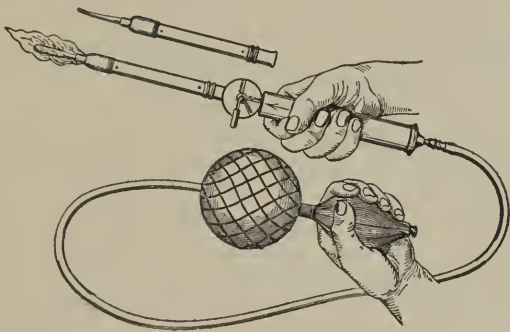


Fig. 25.—Paquelin's cautery. Note that the benzene is contained in the handle of the apparatus (W. E. Ashton).

consists of a hollow, flattened *tip* of platinum, which is screwed on to a small metal *cylinder*, or connected by a rubber tube with a *bottle*, either containing a small quantity of benzene. Attached to the cylinder or bottle is an air-pump, by working which the fumes of benzene are blown into the tip. If the tip is previously heated over an alcohol lamp, the fumes will ignite inside the hollow tip and maintain, by this simple process, the tip at the required degree of heat. The air-pump consists of a length of rubber tubing fitted with two rubber balls, one hard and one soft, the soft one being protected from overdistention by a netting of strong silk. The hard bulb is squeezed

from time to time, thus pumping air into the soft bulb, which acts as a reservoir, and simply from the effect of atmospheric pressure passes the air in a steady current over the benzene. By keeping the soft bulb moderately distended, sufficient force of air and benzene is blown into the tip to keep it at a steady heat. Very little benzene is required; usually the required amount is soaked up on a small sponge or absorbent cotton and placed in the bottom of the cylinder or bottle. If too much is used, the benzene itself may ignite and cause an explosion. The cautery is generally used just below red heat. After use the tip should be brought to white heat for a few moments, in order to burn off any shreds of tissue which may adhere. While cooling, it should be kept in a safe place. It should be allowed to cool slowly, and when quite cold, may be washed and cleaned like other instruments. The platinum tips are very costly, platinum being a more highly priced metal than gold; they require the greatest care in handling, as when heated, the smallest knock or fall will dent them, thus destroying the even surface necessary. For this reason the cautery should always be in charge of a reliable nurse, but every pupil should be taught how to put it together for use and the proper care of the different parts.

In hospitals and doctors' offices a modification of the Paquelin cautery is now often found, the platinum tip being screwed on to a convenient handle connected with an electric current. Where the heat is supplied by electricity, it is not necessary to heat the tip, in the first place, over an alcohol flame.

The cautery is employed for the relief of pain, especially that of muscular rheumatism, to promote the absorption of inflammatory products, and for the arrest of hemorrhage from any vascular surfaces, as, for instance, after the use of the clamp in operations for hemorrhoids. As an escharotic it is used in surgery as an application to wounds when it is desirable to destroy the superficial tissue. To cauterize was, until recently, the classic treatment for all wounds caused by the bites of animals, dogs, cats, serpents, etc. At the present day it is less in favor, free incision being generally preferred.

If a nurse is directed to disinfect the skin before cauterization, she should understand to do so only with soap and water and a disinfectant solution. Alcohol and ether must be avoided, as, on account of their inflammable properties, an accident might happen if they had not been thoroughly removed.

VESICANTS

This form of counterirritation is most generally employed where it is desirable to check the formation of effusion, as in pleurisy, pericarditis, or synovitis of one of the joints. Blistering may be accomplished by using a rubefacient in a more concentrated form or over a longer period, but most commonly a preparation of a Spanish fly, *cantharides*, is employed. It may be obtained in the form of a fluid, an ointment, or a plaster. Where the order to " apply a blister " is given, cantharides is understood.

Before applying a blister the skin should be carefully cleaned with soap and water, alcohol or ether, and a disinfectant, shaving, when necessary, in order that the application may act the more readily, and that the area may be aseptic when the blister is opened. The site chosen should be over a well-covered surface, plentifully supplied with blood-vessels, and not over a bony prominence, where healing would be slow.

The blister is always a small application, usually one to two inches square. This is both on account of the destruction of tissue, and because of the poisonous effect of the drug, which, when absorbed too freely into the system, causes acute nephritis. The symptoms of cantharidal poisoning are headache, vomiting, fever, and scanty urine, containing albumin (p. 239).

Cantharidal Collodion or Blistering Fluid.—The cantharidal collodion is painted on the skin with a camel's-hair brush. In order to keep exactly to the required size and prevent the fluid running, the space may be outlined first with sweet oil or vaselin. Allowing a very few moments for the application to dry, the blister is then covered with gauze and finally with waxed paper, or some convenient protective, and a bandage applied *lightly*, in order to allow for the rising of the blister.

Cantharides Plaster.—The plaster is cut to the required size and applied directly to the surface; it is held in position with a lightly applied bandage.

Cantharidal ointment or *cerate* is also applied directly to the surface, the application being first spread on muslin or lint. It is not so reliable a preparation as either the plaster or the collodion.

After either of the above forms of application the area must be examined from time to time to ascertain if the blister has risen. From four to eight hours is usually required to form the single large bleb desired. If it has not formed at the end of eight hours, the application should be removed and a poultice or a hot fomentation applied to the site. These should not be applied over the application itself, as sloughing and symptoms of poisonous absorption may result. With young children a blister is best removed as soon as the skin is thoroughly reddened, and a poultice applied until the blister has formed.

The collodion or ointment may be removed with ether.

When the blister is well risen, it is opened and dressed with strict aseptic precautions. In opening, a snip is made at the most dependent point of the blister, and the fluid gently pressed out on a piece of sterile cotton. A dry sterile dressing is usually applied, and either changed every day or left in place until the blister is healed, or a daily dressing of boric ointment may be preferred. In some instances the blister is left uncut, and the fluid allowed to be reabsorbed. In this case it is covered with a dressing of sterile cotton and a light bandage which protects it from breaking and aids, by elastic pressure, in the process of absorption. Where it is desirable to keep up the counterirritation, the cuticle of the blister is cut entirely away and the surface dressed with *savin ointment*, an ointment made from the volatile oil found in the tops of the *Juniperus sabina*, intensely irritating, especially to the denuded surface. This dressing should be exactly the size of the denuded surface, covered with an overlapping piece of gauze.

On account of the physical effect of the drug the condition of the kidneys must be carefully watched when blistering is used in the treatment of a patient.

In conditions where effusion is extensive it is frequently desirable to apply the treatment over a greater length of time. In these cases a *flying blister* is ordered. A space is mapped out, divided into four or six two-inch squares, to each of which, on successive days, a blister is applied. After the last space is blistered the first space is usually ready for a second application, if still necessary, or a fresh square may be begun beside the first.

A mixture of *guaiacol and glycerin* is sometimes used as a vesicant, applied and treated in the same way as cantharidal collodion.

Ammonia (*aqua*) or *chloroform* can be used as vesicants where cantharides is unattainable. They may be applied by saturating a piece of gauze the necessary size with one or the other; the gauze is then applied directly to the surface and covered with some protective and a bandage. A group of small vesicles should rise in from ten to fifteen minutes.

Blistering may be also accomplished by pouring a few drops of ammonia water (aqua fortis) directly on the skin, excluding the air by holding a watch-glass over the application until the vesicles rise. Kerosene oil may also be employed with equal parts of sweet oil. It is applied on gauze and covered with some protective.

Pustulants.—Croton oil (*oleum tiglii*) is a powerful vesicant, producing, instead of a blister of clear serum, a collection of small vesicles which quickly become pustulous. Tartar emetic applied to the skin has the same effect. Croton oil may be mixed with equal parts of olive oil and applied on muslin or gauze, covering the application with some protective; more commonly, a piece of flannel or absorbent cotton is soaked with a small amount and rubbed briskly over the skin until the surface is well reddened. The pustules should appear about four hours after the application. If there is no result, the process is repeated.

ESCHAROTICS

Certain drugs brought in contact with the skin destroy the soft tissues and cause sloughing. They are termed caustics or escharotics. While not applied as remedial

agents to healthy tissue, drugs with this property should be known and recognized in order to avoid accidents.

The following list may be memorized:

Acids (undiluted)—acetic, arsenous, carbolic, chromic, nitric, sulphuric; bromin, caustic potash, caustic soda; antimony chlorid, zinc chlorid, lime, mercuric nitrate, silver nitrate, copper sulphate.

LINIMENTS

It must not be overlooked that friction with the open palm of the hand is, in many instances, one of the most valuable forms of mild counterirritant. Its efficacy is increased if oil or alcohol is used. Frequently the oil or alcohol is made the vehicle of a drug with anodyne or stimulating properties, forming what is known as a *liniment*. A sufficient quantity of the liniment is taken on the palm and rubbed into the skin over the affected area. The application is specially employed for affected joints in conditions of subacute and chronic rheumatism, and is applied to the chest in chronic bronchitis. The medicinal substances most commonly incorporated in liniments are aconite, ammonia, arnica, belladonna, camphor, chloroform, hartshorn, mustard, opium, and turpentine. The soap liniment so frequently employed contains alcohol, camphor, opium, and tincture of green soap.

Friction should be given with the whole hand flat, and should, generally speaking, follow the direction of the lymphatic circulation, *i. e.*, from the extremities toward the heart.

PLASTERS

Local application to the unbroken surface is also made in the form of a plaster, or *emplastrum*. The remedial agent is mixed with an adhesive substance such as resin (pitch), which melts at the temperature of the body, and with rubber. The preparation is spread on kid or swansdown and applied directly to the skin surface, where it adheres, as a rule, without other support. If kid is used, it should be freely perforated. Drugs with counterirritant, anodyne, astringent, and other properties are frequently applied by this means. The most commonly employed

plasters are the following, all of which are official preparations:

Asafetida plaster combines the properties of counterirritant and antispasmodic. It is used to some extent to relieve gastric and intestinal distention.
Belladonna plaster, employed for anodyne purposes and for the property possessed by belladonna of drying up secretions; frequently applied to the breasts in order to dry up milk, or to enlarge painful glands. Applied locally to the muscles it relieves pain, such as lumbago, and affords comforting support.
Cantharides plaster (see above).
Capsicum plaster, employed as a counterirritant to relieve muscular pain.
Diachylon or **lead plaster** contains acetate of lead, soap, and water.
Mercury and ammonia plaster (18 per cent. of mercury), used where, besides the counterirritant property, the action of mercury on the system is desired.
Mercury plaster (30 per cent. mercury).
Mustard-leaf (see above).
Opium plaster, applied for anodyne purposes, but less generally than the belladonna plaster.
Soap plaster, a milder form of the lead plaster; both are mildly astringent applications used chiefly in surgery.

The adhesive plaster in general use is made of rubber, petroleum, and either lead acetate or zinc oxid. The astringent property is very slight. Adhesive plaster is used chiefly for support, to exert pressure, and in the application of splints and other external appliances (Chap. VIII).

In applying a plaster care must be taken that it fits the surface smoothly without wrinkles. Snipping the margin freely will generally accomplish this result.

A plaster applied to the breast should be cut circular and a hole made in the center to avoid covering the nipple. Most usually this is the belladonna plaster used to dry up the secretion of milk.

A plaster is left on until the result for which it was applied is attained. An anodyne plaster (belladonna, opium) may be retained as long as it is comfortable unless there are symptoms of too free absorption of the drug. (See Poisons.) In removing, if a plaster does not come away readily, a little turpentine or chloroform will dissolve the adhesive substance, when the plaster can be removed

without pain. If a mustard, capsicum, or cantharides plaster sticks, it should be moistened with sweet oil. Most plasters adhere more readily and are more comfortable if slightly warmed before applying. The skin should be previously washed with soap and water and dried.

Antiphlogistine is a patent preparation (formula unpublished) of medicinal substances and a natural Denver mud, which possesses the property of relieving pain and reducing inflammation. It is spread thickly on stout material, cotton or linen, and applied directly to the skin surface. Unless warmed before applying, it has a disagreeable, clammy feeling. It may be left on for from six to twenty-four hours, after which it becomes dry and uncomfortable. Should some of the preparation adhere to the surface after the plaster is removed, it may be washed off with soap and water. At the present day its use has a certain vogue, especially in the treatment of subacute inflammations.

CHAPTER IV

ENEMATA, ENTEROCLYSIS, CONTINUOUS RECTAL INFUSION, SUPPOSITORIES, DOUCHES, TAMPONS, CATHETERIZATION, LAVAGE, GAVAGE, NASAL FEEDING

Simple, Purgative, Nutritive, Medicated Enemata—Suppositories—Douches, Vaginal, Intra-uterine—Vaginal Tampon—Vaginal Packing—Nasal, Ear, and Eye Douches—Catheterization—Bladder Irrigation — Guarded Catheter — The Male Catheter — Lavage — Gavage — Nasal Feeding.

ENEMATA

An enema, or clyster, is a fluid injected into the lower bowel by way of the rectum. It is employed to relieve constipation, to check diarrhea, as a vehicle for the administration of food, water, medicine, or stimulation to the general system, and as a local application. More rarely it is used as a means of reducing temperature.

The rectum, it will be remembered, is the lowest division of the large intestine; the opening is known as the *anus*, and is guarded by a sphincter or ring muscle called the *sphincter ani.* It is a straight passage, occupying the posterior portion of the pelvic cavity, and running in a direction from the anus backward and toward the left of the abdomen. About eight inches above the anus the rectum is connected with the descending branch of the colon, or large intestine, by an S-like curve, called the *sigmoid flexure*, which passes over the bony brim of the pelvis into the abdominal cavity.

The walls of the large intestine contain no secreting glands for the digestion of food; in common, however, with all other portions of the intestinal tract, they have the power of absorption. Food, water, medicine, etc., introduced into the large intestine become absorbed and distributed over the general system in the same manner

as when absorbed through the small intestine. Poisonous products present in the colon, as, for example, those formed by decomposing food-particles, are also readily absorbed, and produce symptoms of general systemic toxemia, the earliest manifestations of which are the headache, malaise, and nervous irritability which accompany constipation. To keep the intestines free of such accumulation is a first necessity if health is to be preserved, and to aid in so doing is the most common use of the enema.

The enema is best administered by a tube of soft rubber sufficiently thick to be non-collapsible.

Special tubes of various sizes are sold for this purpose, known as *rectal tubes*. If a very small size is necessary, a large-sized "soft" catheter is used, while for colonic flushing a stomach-tube may be required.

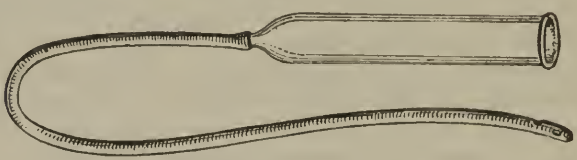


Fig. 26.—Rectal tube with funnel for nutritive or medicated enemata.

The best rectal tube for most purposes has the end of solid rubber, cone-shaped, and the opening on the side about an inch from the tip. When the opening is directly at the end, the opening more readily becomes blocked with the contents of the rectum.

The rectal tube may be connected with the tubing of a douche-can or "fountain" bag by a short glass connecting tube, and where a considerable quantity of fluid is to be ejected, the bag or can is usually used. It should be hung from two to three feet higher than the patient. For the simple enema to relieve constipation the hard-rubber nozzle sold with the fountain syringe bag may be used instead of the rectal tube.

For small enemata, especially those containing drugs, when it is of importance that the entire enema should

reach the bowel, the long tubing has obvious disadvantages. In these cases a funnel is attached to the end of the rectal tube and the enema poured into it from a pitcher. The barrel of a large-sized glass syringe makes the best funnel for the purpose (Fig. 26); its capacity is known accurately, and its shape lessens the risk of spilling. For very small medicated enemata the tube should not be more than eight inches long, and some prefer to use, for this purpose, the ball syringe.

The *ball syringe* is a hollow ball of soft rubber, to which is attached a short, hard-rubber rectal nozzle. The fluid is drawn into the ball by expressing the air and allowing the ball gradually to expand, while the nozzle is held below the surface level of the fluid. When filled, superfluous air must be expressed by holding the ball with nozzle directly upright and pressing gently until the fluid appears at the end. The pressure must not be relaxed or air will be sucked into the vacuum.

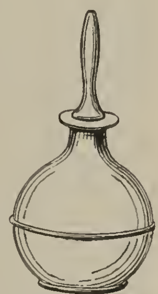


Fig. 27.—Ball syringe.

In giving an enema, care must be exercised to avoid injecting air into the bowel, which causes cramping pains and may produce distention difficult to relieve. To prevent this the tube must be filled with fluid first, and either clamped or pinched between the finger and thumb to retain the fluid while inserting the tube. For the same reason, where the funnel is used, it must be replenished from the pitcher always before it has become empty. If these details are not attended to, the air already in the tube is directly forced into the bowel by the more solid column of water behind it; where a douche-can or bag is used, a considerable quantity may be thus injected.

A second point to be borne in mind is that the first flow of fluid will be chilled by running through the tube and should be run off before the rectal tube or nozzle is inserted if the enema is to be given warm or hot. Where the enema is a measured quantity to be retained, the

portion run off must be returned to the bulk of the enema. The temperature may, where practical, be tested by running the fluid over the back of the hand.

The above details are equally important wherever fluid is injected into the body, either by douche, etc., into the cavities, or subcutaneously into the tissues. The passage of the tube is made easier by lubricating the end well with soapy water. If the mucous membrane is delicate, as in young children, sterile oil or vaselin may be used and the anus should also be lubricated. There is a prejudice against using oil or vaselin unnecessarily; principally because they afford too good a medium for the development of bacteria, but also because all oils have a destructive effect on rubber.

In giving an enema the patient should be on the left side, toward which the rectum is directed, or flat on the back; in either case with the knees flexed in order to relax the abdominal muscles. For special purposes the knee-chest position is ordered. (See Positions, p. 191.) In many cases it is necessary to have the pelvis elevated higher than the natural position of the body; either the pelvis may be raised on pillows, or the lower end of the bed may be elevated on blocks. Under the patient is placed a small rubber sheet covered with a draw-sheet or thick towel; the night-dress is rolled up out of the way, and a single blanket or sheet is used as a covering. The enema may be given entirely under cover; where this is considered undesirable, the covering can very easily be arranged so that only the anus is exposed. The bed-pan or commode should be at hand before the injection is begun.

The tube inserted, it should be pushed gently in one direction upward, backward, and toward the left, using no force. If resistance is felt from the contents of the rectum, some fluid should be run in through the tube; this will dilate the rectum and make room for the tube to pass up beside the impaction. Resistance should not be overcome by moving the tube or nozzle about; this irritates and may injure the mucous membrane, causes pain,

and generally leads to blocking the eye of the tube with feces. If, after insertion, the fluid does not run, the eye has become blocked. The tube must be withdrawn and water run through the tube until the impaction is washed out, after which it can be again inserted.

Instances occur where the rectum is so packed with hard, dry feces that it is impossible to pass the tube. In these cases it becomes necessary to unload the rectum first with the finger, carefully protected by a glove or rubber finger-stall, and freely lubricated. The finger should not be inserted unless thus protected, and this not only from principles of cleanliness, but because the finger-nail may easily scratch the delicate mucous membrane.

Peristalsis[1] is frequently excited on first beginning an enema, leading the patient to imagine he cannot retain it. If this occurs, by pinching the tube the enema can be stopped until the desire to expel it has passed, when it can be continued. By proceeding slowly and frequently pausing, a much larger quantity can be retained than if the enema is injected rapidly and with force into the rectum.

On finishing, the tube is slowly and gently withdrawn, pinching it between the fingers to avoid spilling any fluid remaining. If it is desired to retain the enema, a folded towel is held for a few moments in such a manner that the buttocks are pressed together over the anus.

An enema is prescribed to be given either *low* or *high*, terms which signify which part of the colon it is desired to reach. In giving a low enema the tube is passed only into the rectum, a distance, that is, of from four to eight inches. In giving a high enema the object is to reach as far up the colon as possible, and the tube must be passed beyond the sigmoid flexure, more than eight inches. To do so requires patience and skill; the curve must be passed by gentle manipulation, and force on no account used. Frequently the tube appears to slip easily into place,

[1] Peristalsis is the rhythmic, wave-like contraction of the muscular walls of the stomach and intestines by which food is propelled forward in the direction of the anus. It is excited by the presence of food, etc., in the stomach and intestines.

but if an examining finger is passed into the rectum, it will be found to have coiled back on itself and to be lying entirely in the rectum. Sometimes a tube of large caliber is more easily passed than a small one. Once past the sigmoid flexure, the tube should be pushed forward as long as it meets no resistance. When resistance is met, the tube is withdrawn an inch or two and the enema started.

The simple enemata for relieving temporary constipation, and those employed as a local application, are given *low;* practically all other enemata should be given high.

The *temperature* of an enema varies with the results to be attained. A purgative enema is given hot—from 100° to 105° F.; a stimulating enema, from 105° to 110° F.; an enema for the arrest of local hemorrhage, 110° to 120° F.; an enema for nutritive purposes should be about the normal temperature of the body; a bland enema is usually given cool, that is, the chill just off, while for special purposes, such as the reduction of the temperature of the body or the arrest of local hemorrhage, and in the treatment of acute dysentery or cholera, an enema may be ordered cold or even iced. In the majority of cases an enema which is the vehicle for a drug is given cold or cool, in order not to risk altering the active properties of the drug by heat: to this rule the medicated purgative enema is an exception.

The quantity given by enema also varies greatly. The common purgative enema is usually from two to four pints for an adult, from one to two pints for a child, and half a pint for an infant. When given in order to empty the bowel before an operation, the enema is repeated until it returns clear. If it is desired to retain the enema, the quantity is small, anything above six ounces being liable to be rejected or to excite peristalsis, which may cause the whole to be returned.

In the care of an *infant* the giving of an enema may be a frequent duty, and is one which requires to be performed with the greatest care and attention to details. A small-sized rubber catheter is used, attached either to the glass funnel or to the douche-bag. The infant is laid comfortably on its left side on the lap, on which is a small

blanket covered by a rubber sheet, both warmed; the clothing is rolled up out of the way, and a warm diaper placed under the buttocks. The legs are flexed and the baby held by the feet. The anus, the adjacent parts, and the tube are carefully lubricated with sterile vaselin or cold cream. The enema is then given in the usual way. If the tube and funnel are used, the nurse will require an assistant to help her; if the bag or can is used, it should be hung about a foot higher than the lap, and the tube appropriately shortened. The injection over, a suitable vessel is placed under the buttocks, and the baby, covered with a warm blanket, is held on the lap until the enema has acted. Owing to the smallness of the limbs a large proportion of the baby's body is necessarily exposed during the process. Care should, therefore, be taken that the proceeding takes place in a well-warmed place, free of drafts, preferably by an open fire, and that all that comes in contact with the baby is well warmed. A baby should not run the risk of sudden chilling of the surface of its body.

The following are the more commonly ordered enemata; the quantities given are those for an adult.

Simple Enema.—Plain hot water may be used as an enema to relieve mild constipation or to empty the rectum before rectal feeding. It is sometimes ordered for invalids who imagine that the soap-suds enema causes griping. Quantity, two to four pints; temperature, 100° to 105° F.

Soap-suds Enema.—Hot water is made soapy with Castile or any pure soap. No soaps containing much soda, such as scrubbing or laundry soap, should be used, as they are irritating to the mucous membrane. The frothy suds which contain air-bubbles should not be injected, as they will cause unnecessary griping. The soap-suds enema is used to induce an action of the bowels. Quantity, two to four pints; temperature, 100° to 105° F.

Normal Salt Solution Enema.—To two pints of water are added two and one-quarter teaspoons of common table-salt ($\frac{9}{10}$ of 1 per cent.). The normal salt solution enema is used for various purposes: to irrigate the lower

bowel in conditions of chronic enterocolitis, to cleanse the bowel before rectal feeding, for the destruction of intestinal worms, for the relief of thirst, especially following an operation or severe hemorrhage, and as a means of stimulating the system in conditions of collapse; usual temperature, 110° to 105° F.; as a general stimulant, 110° to 120° F.

Nutritive Enema.—Nutritive enemata may be composed of any concentrated food substance in liquid form. They commonly contain peptonized milk, egg, some concentrated protein, such as a beef essence, beef-juice, peptones, or liquid peptonoids. As absorption only, and not digestion, is carried on in the large intestine, the food used is first partially digested or *peptonized*, unless already in the form of peptones or albuminoids, which are ready for absorption without being subjected to the action of digestive secretions.

A common formula for a nutritive enema is as follows:

Peptonized milk, 3 ounces.
Beef-juice, 2 drams.
White of one egg.
Salt, half a level teaspoon.

The beef-juice may be omitted altogether or bouillon (2 ounces), liquid peptonoids (half an ounce), beef peptones, or some beef-extract (1 to 2 drams) may be used in its place. Half an entire egg is sometimes preferred to the white only, or the egg may be omitted and a larger quantity of beef-juice used.

(To peptonize milk see Appendix.)

In preparing the enema the milk is warmed in a double boiler to the required temperature (95° F.), and the salt and beef-juice added when ready. The egg-albumen is broken in a cup with a spoon and added last, slowly, stirring all the time.

If stimulants or medicines are to be given in the enema, they are added immediately before administration and not subjected to the process of predigestion. Stimulants —whisky or brandy—must be added slowly, stirring all the time to prevent curdling. Medicines should be given with the first quantity injected, so that nothing may be lost in the tube.

A nutritive enema should not exceed from four to six ounces, a larger quantity being liable to be rejected, and should be given high; it should be about the consistence of thick cream. If not sufficiently thick, a little cooked starch or flour may be added. To insure retention it must be given very slowly, almost drop by drop, regulating the speed by pinching or clamping the tube. The pelvis should be raised higher than the shoulders during the process. The enema is usually given at intervals of four, six, or eight hours, according to circumstances.

The nutritive enema, or rectal feeding, is ordered in cases where, from any cause, the patient cannot be fed through the stomach. Such a condition may be the result of gastric ulcer, cancer of the stomach, stricture of the esophagus, persistent vomiting, and similar causes. Rectal feeding may be the only means of nourishment for weeks at a time. In these cases it is important to keep the bowel free from accumulations of food-particles, which, when not absorbed, must decompose, and, as a consequence, set up diarrhea, which will render rectal feeding impossible. To prevent this, the bowel is cleansed at least once a day by a simple enema, or, if preferred, by an enema of soapsuds or salt solution. Some doctors order a small (half a pint) simple enema half an hour before each feeding, but such frequent passing of the tube is liable to irritate the mucous membrane. After the enema is given, the patient should lie quite still for half an hour.

Stimulating Enemata.—No. 1: The normal salt solution enema, given at a temperature of 110° to 120° F., is a valuable general stimulant in conditions of shock, lowered vitality, or collapse. It should be injected as high as possible into the colon, and not more than one pint given at a time to favor retention.

No. 2: Strong black coffee, four to six ounces, to which may be added brandy or whisky, one to two ounces. It is also given high, at a temperature of 105° to 110° F. To make a coffee enema quickly tie a cupful of ground coffee loosely in a piece of muslin, place in the coffee-pot, and pour on two cups of boiling water; cover and set on

the stove three minutes, then strain. Less coffee is necessary if more time is available.

No. 3: Brandy or whisky (one to two ounces) is frequently ordered as an emergency stimulating enema. They are usually given diluted with hot normal salt solution; hot milk, hot tea, or hot coffee may also be used as vehicles. The total quantity should not be more than six ounces. If the stimulant is to be frequently repeated, it is best given in four ounces of cooked starch, to lessen the irritating effects of alcohol on the mucous membrane.

Medicated Enemata.—Drugs or medicinal preparations may be given by enema either for local action or for general systemic effect. When for the latter use, a larger dose is given than when the drug is administered by the mouth or by subcutaneous injection. In the majority of instances the dose by rectum is *twice that given by mouth.* Medicated enemata are given high, unless for local action only.

Oil Enema.—From six ounces to a pint of olive oil is warmed to a temperature of about 90° F., and given very slowly as a high enema. In from two to six hours it is followed by a suds enema.

The oil enema is given to soften hard masses of feces, and is frequently ordered before the first bowel movement after rectal operations.

The tube used must be immediately cleaned, as oil quickly destroys rubber.

Glycerin Enema.—Glycerin, ½ ounce, diluted with an equal quantity of warm water, is frequently used for the relief of chronic constipation affecting the lower bowel. It is most conveniently given with a special glass syringe fitted with a hard-rubber nozzle slightly curved, and about four inches long.

Medicated purgative enemata are used in cases of obstinate constipation. Salts, either Rochelle or magnesium sulphate, or castor oil are used for this purpose.

Salts Enema.—To from 4 to 6 ounces of Rochelle salts, or from 2 to 4 of sulphate of magnesia, add sufficient hot water to make a saturated solution. The enema

is given at bedtime and followed in the morning by a suds enema.

Castor-oil Enema.—Make an emulsion of castor oil by adding to the quantity ordered an equal quantity of hot milk or hot strong coffee, and shaking well together in a corked medicine bottle. Give slowly, like a nutritive enema, and follow by a suds enema in from one to four hours.

Compound Purgative Enema.—An enema that has excellent results in relieving post-operative constipation without giving an aperient by mouth consists of magnesium sulphate, 1 ounce, glycerin, 1 ounce, turpentine, $\frac{1}{2}$ ounce, in hot water, 4 ounces.

Carminative enemata are used to dispel collections of gas in the bowel and so relieve distention. Turpentine, asafetida, and alum are the drugs most commonly used.

Turpentine Enema.—First method: Beat with a knife from 2 drams to $\frac{1}{2}$ ounce of turpentine into a pint of a hot suds enema; give in the usual way, and follow, without removing the tube, by another pint or pint and a half of the suds enema.

Second method: Add from $\frac{1}{2}$ ounce to 1 ounce of turpentine to 4 to 6 ounces of warm olive oil, mixing well with a knife or by shaking in a corked medicine bottle. Follow in from half to one hour with a suds enema.

Asafetida Enema.—The milk or emulsion of asafetida, which contains 10 grains of asafetida in each ounce, is the preparation generally used. From 1 to 2 ounces are given in equal quantity of hot water at a temperature of 100° to 105° F. Other medical substances may be combined in the asafetida enema, as in the following formula, known as the *compound asafetida enema:* Milk of asafetida, 3 ounces; magnesium sulphate, 1 ounce; oil of turpentine, 30 minims; glycerin, 1 ounce. The enema is warmed by standing in hot water. It should be given high and slowly, and followed by a suds enema in about twenty minutes or half an hour.

Alum Enema.—Alum, from 2 drams to $\frac{1}{2}$ ounce in 1 pint of hot water, is sometimes ordered for the relief of obstinate and dangerous distention. It must be used with caution on account of the poisonous properties of the drug

when taken in large doses. If the enema is retained, it should be siphoned off after half an hour. To remove an enema by siphoning the rectal tube is passed and the free end lowered over a vessel placed at a lower level than the pelvis.

Gelatin Enema.—In cases of hemorrhage from the stomach or upper bowel or other points where the bleeding point cannot be reached gelatin, which aids in the clotting property of blood, is frequently given as a rectal injection. The gelatin is dissolved in hot water until sufficiently thin to run through a tube, and from 4 to 6 ounces at a time given, generally every eight to twelve hours.

Astringent Enema.—Astringent injections are most frequently given in the form of rectal irrigations or douches. An exception is the *quassia enema* for the destruction of seat-worms. An infusion is made from chips of quassia wood, a tree native to Jamaica, by pouring a pint of boiling water over one ounce of the chips (by weight). When cold, the water is strained off and injected cold. The bowel should first be cleared by a simple enema. Half a pint is given at a time, and the enema generally repeated daily until all the worms have been hatched out and destroyed. The enema is retained half an hour, the patient during that period being kept quietly lying down. If not returned naturally, it should then be siphoned off.

Starch, Emollient, or Bland Enema.—A starch enema is used to relieve local irritation, to check diarrhea, and as a vehicle for the introduction into the rectum of drugs given in small doses, as, for example, the tinctures. The starch is cooked in the usual manner, by dissolving a small quantity in cold water and adding boiling water until it is sufficiently thin to run through the tube. When it has cooled to the *normal bodily temperature*, it is ready for use.

When a drug is used, it is added, immediately before the injection is given, to about ½ ounce of the starch; this quantity is first injected, and followed immediately by 2 ounces more of starch. By this means the risk of some of the drug being left in the tube is lessened.

A starch enema containing from 10 minims to 1 dram of tincture of opium is used to check obstinate diarrhea. It soothes the local irritation, checks peristalsis, and allays pain. The poisonous properties of opium must be borne in mind, and close watch kept for the premonitory symptoms of an overdose, especially if ordered for children, who, it cannot be too frequently emphasized, stand opium very badly. As the starch does not flow easily, this enema is best given with an ordinary glass or a ball syringe attached to a short length of a rectal tube, a method that may also be employed in giving either an oil or a nutritive enema that proves difficult to inject in the usual way.

Other drugs, ordered in larger doses, when given by rectum, are dissolved in warm (not hot) water or warm milk. The quantity of fluid should not be more than two or three ounces; the drug is dissolved in half the quantity, and that half given first, the remainder following immediately. Sedatives, such as bromid, chloral, chloralamid, trional, etc., are given in this way. As in administering narcotics in any form, the patient must be composed for sleep before a sedative enema is given.

ENTEROCLYSIS

Enteroclysis, or intestinal irrigation, by which is meant the flushing out of the lower bowel with a quantity of fluid, is a form of treatment used in many conditions. The more important are as follows: in the treatment of intestinal disorders, especially those associated with chronic diarrhea or chronic constipation; for the destruction of seat-worms; as a local application to the mucous membrane; as a disinfectant to the bowel; to restore fluid to the body after hemorrhage; as a general stimulant in conditions of shock and collapse; and to reduce high temperature. The irrigation is continued for a specified time—usually from five to fifteen minutes; in some conditions a continuous irrigation is ordered to be maintained for many hours. The quantity ordered may vary from a couple of pints to several quarts. The greater portion

of the fluid is returned at once, though a certain amount is necessarily absorbed.

The patient lies on the back or on the left side, unless specially ordered in the knee-chest position (p. 191).

In giving an enteroclysis a second rectal tube is generally used to carry off the return flow. The irrigating tube is connected to the douche-can or bag containing the fluid, while the second or return tube is attached to a piece of tubing sufficiently long to carry the fluid to a bucket or convenient receptacle placed lower than the pelvis. The return tube is introduced only a few inches up the rectum. A bed-pan or douche-pan is placed under the patient, as some leakage of the fluid is very apt to take place from the anus. If the fluid does not return easily, the return tube is removed and the free end of the irrigating tube lowered over the bucket. In this way the contents are siphoned off.

The enteroclysis may also be given adequately by injecting a pint at a time and siphoning off the amount.

Special double tubes can be obtained to be attached to the rectal tube, and connected by separate arms to the irrigating and return-flow tubes. If such a tube is used, the lower or return-flow tube should be clamped while the fluid flows in, otherwise there is some risk that the fluid may return immediately without irrigating the bowel.

An enteroclysis should be given slowly and without force. The funnel or douche-can should be about two feet above the body. To assist in sending the irrigation as high as possible, the pelvis should be raised higher than the shoulders.

Plain sterile water, normal salt solution, and either astringent or bland solutions are used for enteroclysis.

Normal Salt Solution.—At a temperature of 100° to 105° F. enteroclysis of normal salt solution is used to cleanse and disinfect the bowel in many diseases of the intestine; to restore fluid to the body after severe hemorrhage; and to allay thirst after abdominal operations: given cold (70° to 60° F.), it is employed to reduce bodily temperature, and hot (110° to 120° F.), as a general bodily stimulant in conditions of shock or collapse. In

these cases the enteroclysis must be given with caution, and the pulse as closely watched as when heat or cold is applied to the body by any of the methods described in the previous chapter.

Astringent Enteroclysis.—Tannic acid, half a dram of the crystals to the pint of water, is the most commonly used astringent in the treatment of various diseases of the intestines associated with diarrhea, and especially in the treatment of infantile enterocolitis. In the latter case from 1 to 4 pints, 5 to 10 grains to the pint, is given once a day, care being taken to siphon off the injection if it does not return freely. Nitrate of silver (10 to 20 grains to the pint—adult) is also ordered in cases of dysentery. The temperature usually ordered for an astringent enteroclysis is the normal bodily temperature, but in some cases (dysentery, cholera) it is especially ordered cold. The treatment may be ordered daily or two or three times a week.

Bland Enteroclysis.—The bland enteroclysis is ordered as a local application in chronic irritated or ulcerated conditions of the intestinal mucous membrane, especially of the rectum. Flaxseed tea, barley-water, and thin gruels are used, from 1 to 4 pints being given once a day or on alternate days, generally at the normal bodily temperature.

Flaxseed Enteroclysis.—Pour 1 quart of boiling water over 2 ounces of flaxseed (use the seeds and not the meal), stand in a warm place until thickened, then cool to the desired temperature, and strain. Use undiluted.

Barley-water.—Wash 2 ounces of pearl barley in cold water until clean, and strain off the water. Pour over the barley 2 quarts of boiling water, simmer until reduced to 1 quart, cool and strain; use undiluted.

Gruels.—Stir two teaspoons of oatmeal flour in a pint of cold water, bring to the boil, and boil ten minutes, stirring all the time. Cool and strain; dilute if too thick to run through the tube.

The bland enteroclysis may be ordered high or low, according to which part it is desired to subject to the treatment.

A nurse may be required to get a patient ready for colonic flushing, often inaccurately called abdominal flushing. Normal salt solution at a temperature of 100° F. is generally used, and the flushing given with a small-sized stomach-tube, well lubricated and passed high up the colon. The patient is placed in the knee-chest position and covered with an examining sheet (p. 191). The operation is both a trying and a tiring one. Everything to be required should be at hand before beginning, so that the nurse is free to give all her attention to the patient.

CONTINUOUS RECTAL INFUSION OR SEEPAGE

A continuous flow, usually of hot normal salt solution (105° to 110° F.), into the rectum is a form of treatment after some major abdominal operations and in other conditions of lowered vitality. A douche-can containing the fluid is attached to the head of the bed, a very little higher than the patient's pelvis. The tube is loosely knotted or partially clamped, so that the fluid flows drop by drop. The can must be closely covered to retain the temperature, and the bed protected with a rubber sheet in case of oozing.

A special short rectal tube of hard rubber with an olive-shaped expansion at the nozzle is generally easily kept in place. At one hospital a large-sized "thermos" bottle is ingeniously used for the purpose of seepage. The cork is fitted with two pieces of glass tubing, to one of which the tubing is attached, the other introducing the necessary air to cause the solution to flow. The bottle is attached to the railing at the head of the bed, a few inches higher than the mattress. The method is simple to handle, and has the advantage of keeping the solution at the required temperature. The fixed position the rectal infusion entails makes it a trying process for the patient. Whether in the recumbent or the upright position, every effort must be employed to make him as comfortable as possible by a judicious arrangement of pillows, etc.

SUPPOSITORIES

A suppository is a solid, conical preparation, about an inch long, for introducing small doses of drugs, concentrated foods, or local applications into the rectum, vagina, or, more rarely, the urethra. They are usually made with cocoa-butter, which melts at the bodily temperature, setting free the drug contained. A rectal suppository should be lubricated with oil and passed as far into the passage as the finger will reach, the patient lying on the left side. The finger should be protected by a finger-cot and also lubricated. Drugs are administered in this way either for general systemic effect or for local action. Drugs frequently given in this way are morphin, opium, cocain, gall, lead, tannin, and iodoform. To keep them from melting, suppositories should be kept on ice.

Glycerin jelly, in the form of a suppository, is frequently used as a remedy in mild forms of constipation due to muscular inertia of the lower bowel, for which purpose also a suppository of **white household soap** is effectual. To make the latter, cut a splinter of soap and wash it in hot water until it is smoothly rounded. It may be about three inches long and shaped like a pencil.

An **ice suppository** may be ordered for local hemorrhage or to relieve local inflammation. A lump of ice of suitable size and shape is washed until all sharp corners are rounded off, and introduced by the finger into the rectum. In treating local hemorrhage the suppository is repeated at short intervals.

Suppositories larger in size are also used for introduction into the vagina, and are a form of application frequently used in treatment of the cervix uteri. In giving a vaginal suppository the patient lies on her back with the knees flexed; the suppository is inserted as far as the finger can be introduced. Smaller suppositories are also made for urethral applications, but are not so generally employed. They are shaped like a fine pencil and are inserted as far as they can be pushed from the outside.

DOUCHES

A douche is a local bath of running water, and is used as a means of applying treatment to the various cavities of the body. A douche may be used to cleanse the cavity free of discharge, to apply heat or cold to inflamed surfaces, to arrest local hemorrhage, or to apply medicinal treatment to the parts. The parts to which douching is applicable are the vagina, uterus, bladder, the nose, the ear, and the conjunctival cavity or sac.

Vaginal Douche.—The vagina is a passage or cavity situated between the bladder and urethra in front, and the rectum behind, and curves backward, upward, and finally slightly forward. The length of the anterior wall is about four inches. It terminates in a dome or pouch from the center of which the cervix or neck of the uterus hangs free. The walls of the vagina are capable of enormous distention. When not distended, the mucous membranous lining lies in numerous folds, which readily form a lodging-place for secretions or discharges.

In giving a vaginal douche, even for simple cleansing purposes, everything used should be scrupulously sterile. The special reason for this is that in many conditions the cervix is slightly relaxed, in which case there is some danger that a portion of the douche may be washed into the cervix, and so on into the uterine cavity. It will be remembered that the uterine cavity has two openings at the fundus, one into each Fallopian tube, the fine terminations of which open directly into the peritoneal cavity and form thus a direct channel of communication from the mouth of the vagina to the peritoneal cavity, the largest and most important closed cavity of the body. We remember that these closed cavities present ideal conditions for the development of bacteria, and a douche carelessly prepared or administered may be the means of introducing bacteria into the peritoneal cavity, and setting up septic peritonitis. While the percentage of such accidents is very small, no patient should be allowed to run the most remote risk.

For the same reason, in giving the vaginal douche, no force of water should be used; the can or receptacle for the water should not be elevated more than two feet, and where

infectious discharges are present, it should be held just sufficiently high to allow the water to flow.

The douche is usually given from a douche-can of enameled iron, to which is attached a piece of tubing of sufficient length connected with a vaginal nozzle. The vaginal nozzle is usually of glass, about 6 to 8 inches long, and curved to follow the line of the vagina: the end is rounded, with perforations at the side, which prevents the stream of water being directed immediately on to the cervix. Can, tubing, and nozzle are sterilized, usually by boiling, immediately before use. The patient is placed in the dorsal position (p. 189) on a douche-pan, the knees drawn up, and the pillows removed; she is covered with a single sheet, and the night-dress rolled out of the way. In this way she lies with the pelvis slightly elevated. The douche-pan is a flat receptacle of porcelain or enameled iron, differing somewhat in shape from a bed-pan, and of a larger capacity: it may be made more comfortable if a small pillow or folded towel is placed where the back rests.

If there is any discharge, the external parts should be carefully cleansed before the douche is given, using either hot sterile water or boric solution (2 per cent.). As in the case of a rectal injection, air must be excluded by filling the tube and nozzle before starting the douche; some of the fluid also should be run over the back of the hand until it runs hot, the first flow being chilled by running through the cooler tube. The sheet is turned back to the knees and a sterile towel laid across the pubes: the nozzle is then gently introduced for about 6 inches, and the douche given without removing it. The vagina not being guarded by a sphincter, the douche returns easily by the side of the nozzle, and a continuous flow is kept up. As the fluid dilates the cavity the walls of the vagina are stretched and cleansed and the cervix lies in a continual bath, while the adjacent parts receive the benefit of a hot application. When the douche is over, the nozzle is removed and the patient dried with the sterile towel. A douche is generally given at a temperature of from 105° to 110° F. and higher (115° to 120° F.) if ordered for the arrest of local hemorrhage. Very rarely it is ordered cold.

The thermometer used in ascertaining the temperature of sterile solutions should be kept in alcohol or an antiseptic solution and handled only with freshly sterilized hands or forceps.

Sterile water, normal salt solution, or a mild antiseptic is usually employed for douching. Boric acid is the mildest antiseptic and probably the most frequently used, in a 2 per cent. solution. (See Solutions.) Stronger antiseptics, such as carbolic or bichlorid of mercury, if ordered, are used at from one-half to one-fourth the strength used for the external surfaces; again on account of the risk of reaching the uterine or peritoneal cavities, and their absorption into the system through these channels. A douche of the bichlorid of mercury, 1 : 4000, has been known to produce symptoms of general mercurial poisoning. The A B C douche in common use in some hospitals contains alum, 1 ounce; boric acid, 4 ounces; carbolic acid crystals, 3 drams; oil of peppermint, $1\frac{1}{2}$ drams; two drams of the powder are added to one quart of sterile water. The quantity used for a douche varies—commonly one to two quarts once or twice a day are ordered.

Intra-uterine Douche.—The intra-uterine douche is never ordered as a matter of routine treatment, and is, except in grave emergencies, always given by the physician.

Unless for an immediate emergency, such as a uterine hemorrhage, when every moment is valuable, the parts are usually prepared as carefully as for a vaginal or uterine operation, the strictest asepsis being observed throughout. The patient should void her urine before the preparation is begun. The external parts of the vagina are washed with green soap and hot sterile water, followed by a hot vaginal douche, usually of bichlorid of mercury, 1 : 5000. To cleanse the vagina pledgets of gauze are used on a pair of long curved forceps known as uterine dressing forceps. The thigh and pubes are covered with sterile towels or by an examining sheet. Under the patient is placed a Kelly pad (p. 548), covered also with a sterile sheet, and with the apron directed into a bucket. As it is necessary to have the vagina in a good light, the patient, if the douche is given in the room, lies in the dorsal (p. 189)

position across the bed, the buttocks brought to the edge of the mattress; the legs are flexed and supported at the knee and heel by two assistants. A sterile gown and gloves are usually worn by the operator. A speculum (p. 196) is passed into the vagina and adjusted until the cervix is seen in a good light, and the douche nozzle is then passed without force into the cavity of the uterus as far as the fundus, a distance of between 2 and 3 inches from the cervix in the non-gravid uterus. The nozzle must be full when passed, and the first chilled fluid have been carefully run off. The temperature of the douche is usually 115° to 120° F. Special long curved douche nozzles are used for the intra-uterine douche; if none are available, the female glass catheter is often substituted. After the douche a sterile perineal pad is applied; in some cases the vagina is lightly packed with sterile gauze, the packing remaining until the next day.

The return flow of the intra-uterine douche should never be thrown away until inspected by a responsible person. All shreds, etc., it may contain should be saved and shown to the physician.

When given immediately after parturition for the arrest of hemorrhage, the procedure is more simple, as the cervix is not only already dilated, but obliterated, the mouth of the uterus being as wide as the cavity, and the parts have generally been kept sterile. In this instance, if alone with the case, a nurse may have to act for herself. The hands and arms must be thoroughly disinfected, and the hands, if possible, covered with rubber gloves. The vaginal douche nozzle will pass easily, and should be directed backward and then forward in the line of the birth-canal until the fundus is felt. The douche is given at a temperature of 120° F. It acts by exciting uterine contractions and so closing the large, open uterine blood-vessels. In this instance, while giving the douche with the right hand, the left hand should apply massage to the fundus through the abdominal wall in order to help in exciting uterine contractions. It must then be remembered that only the right hand is sterile.

When it is desirable to enlarge the opening to the vagina,

either for purposes of cleansing, to apply treatment, or for examination of the cavity, a speculum is passed (p. 196). In passing the vaginal speculum the patient may lie equally conveniently on her left side or on her back.

The Nasal Douche.—Except for cases of chronic nasal discharge, the nasal douche is not at the present greatly used. For other affections the spray is preferred. In giving it the usual douche-can may be used, and the tubing attached to a special nasal nozzle, or the douche may be given with a rubber-ball syringe fitted with a fine nozzle. The douche-can should be elevated just sufficiently high

Fig. 28.—Nasal douching with fountain syringe (Manhattan Eye, Ear, and Throat Hospital nursing book).

for the water to flow; the usual precaution of filling the tube and nozzle before beginning must be observed, and the first chilled flow run off. A basin for the return flow is held below the chin. The head of the patient should be bent forward and his mouth open; the tip of the nose is tilted upward, and the nozzle introduced directly backward. In this position the fluid enters at one nostril, irrigates the posterior nares, and returns through the other nostril. Each nostril is treated in turn. A child may be told to breathe audibly during the process through his mouth. This will prevent his swallowing the douche or

choking. Usually the douche is given at a temperature of 105° to 110° F., and consists of sterile water, normal salt solution, or some mild antiseptic or astringent solution. If given to arrest hemorrhage, as after some local operation, or in persistent epistaxis, the nasal douche may be ordered ice cold, or contain some styptic, such as iron, tannin, or adrenalin. More commonly, styptics are applied by spray or direct application

The Ear Douche.—To give an ear douche properly is a delicate matter and one not often intrusted to the pupil nurse. At the end of the short auditory canal is the delicate tympanum or drum, upon the integrity of which depends largely the power of hearing, the sound-waves being transmitted through its vibrations to the middle ear. In a normal condition it is kept in a state of equal tension by pressure of air on either side—air which enters from the auditory canal externally, and internally through the Eustachian tube at the back of the throat to the chamber of the middle ear. If this even relation is altered, as, for instance, from the blocking of a Eustachian tube, we get deafness resulting. A volume of water directed against the tympanum from one side must immediately alter the evenness of this pressure, and if directed with sufficient force or violence, may injure or even permanently impair the delicate membrane. A small douche-can and tube may be used, placed only a few inches higher than the ear, but usually the douche is given either with a glass or ball syringe of soft rubber.

The douche commonly used is boric-acid solution (2 per cent.). The temperature of the douche is usually from 100° to 105° F., the skin being more sensitive to heat than is the mucous membrane. The patient sits with the head erect in a good light, the clothing protected by a small rubber sheet and towel laid round the shoulders and pinned round the neck. Under the ear is held a small basin, kidney-shaped, if it is procurable, for the return flow.

The auricle or outer ear is held slightly backward and upward in giving the douche, which brings the auditory canal in a straighter line with the irrigating nozzle. The

nozzle must not be pushed beyond the opening of the auditory canal and the irrigation be carried out very gently. When it is finished, any moisture is sopped up from the canal with small pledgets of cotton, changing them until perfectly dry. A small dry pledget is generally left temporarily in the ear.

The ear is douched for the removal of discharges, in inflammatory conditions, to allay pain, and for the removal

Fig. 29.—Syringing an ear (Manhattan Eye, Ear, and Throat Hospital nursing book).

of impactions of wax and of foreign bodies, in which latter condition the procedure is a little different. (See Foreign Bodies, p. 671.) The facility with which the ear may be injured by careless douching cannot be too greatly emphasized.

The Eye Douche.—Few details of nursing are more important and more often inadequately performed than the eye douche. The purpose is thoroughly to irrigate every corner of the conjunctival sac; in point of fact, the

average douche does little beyond cleansing the surface immediately behind the margin of the lids. The conjunctiva may be described as beginning at the margin of one lid, lining the lid, doubling back to cover the eyeball, and again folding to line the second lid, at the margin of which it terminates. By thus folding, the conjunctiva presents two surfaces which are continuously rubbing together. If the margins of both lids are picked up separately and held away from the eyeball, a small pouch is formed lined entirely by the conjunctiva. This constitutes the conjunctival sac. If irrigation is attempted while the lids lie against the eyeball, the upper and lower corners of the sac are not reached. The upper lid first should be held well away from the eyeball, taking the margin gently between the finger and thumb, and the douche thoroughly administered. The lower portion of the sac can be thoroughly opened by pulling the loose tissue of the under lid gently down against the cheek bone. The stream should be directed from the inner corner of the eye outward. The patient may sit on a chair with the head held backward and slightly to the side of the eye under treatment, a basin being held conveniently to catch the overflow. A small douche-can with about three feet of tubing fitted to a medicine-dropper or fine glass nozzle is generally used, though a small rubber ball syringe is also practical. A glass syringe may be used, but has the disadvantage that it takes two hands to fill it. Some small sterile cotton or gauze sponges are required to cleanse the lids and dry them after the douche, each sponge being used only once and discarded. If both eyes are to be treated, as in infectious cases, a second nozzle or syringe should be used to avoid infecting one eye from the other, and the hands should be thoroughly rinsed in bichlorid of mercury solution between the treatment. Strict asepsis must be observed. In douching before or after an operation the douche-can should be elevated about 6 inches: where purulent discharge has to be washed away, a height of from 12 to 18 inches is generally ordered. Force must not be used. The only instance in which force is beneficial is where highly irritating matter, such as quicklime, has

got into the eye. In these cases frequently the only immediately available treatment is to hold the eye open under a faucet of running water. (See Emergencies, Chapter XIX.)

In **irrigating an infant's eye** the nurse, seated on a low chair, should hold the baby across her lap, the head at the edge of the knee, with the face turned from her. Rolling the baby in a small blanket will pinion the arms and prevent struggling. A piece of rubber sheeting with a circular piece cut out of one end is fastened round the baby's neck so that the clothes are protected, and at the same time the cheek rests on the rubber. The free end of the sheeting is caught into a clean vessel on the floor. The nurse has then both hands free—one to open the lids, the other to manipulate the nozzle. In order that discharge may not run across the nose from one eye to be other the head must be turned toward the side of the eye to be treated. The nozzle is directed toward the inner corner, so that the discharge is washed outward. If only one eye is to be treated, the sound eye should be protected by a sterile pad or covered with a watch-glass during the process.

In the case of ophthalmia neonatorum, the ophthalmia of the new-born, when want of thoroughness may result in permanent blindness, it should be a strict rule that the douching should be done by two nurses. To open the swollen lids thoroughly takes one pair of hands entirely, and it is of the first importance that every corner of the sac should be freely exposed to the douching.

TAMPONS

The Vaginal Tampon.—The tampon is, at the present day, not in constant use; a nurse should, however, be instructed how to prepare and how to insert one.

Tampons are usually made of absorbent cotton, cut into strips three inches wide, rolled tightly into little bolsters, and tied round the center with securely knotted silk or string, the ends of which are sufficiently long to come beyond the mouth of the vagina when the tampon is in position. Two or three may be tied a few inches apart

on one string, forming what is known as a **kite-tail** tampon. The tampon is sterilized and usually saturated with glycerin (sterile), 1 part, to sterile water, 2 parts, but it may also be soaked in any solution which it is desirable to apply to the parts. Strict aseptic technic is, of course, to be observed.

To introduce the tampon the patient lies on her back with the knees flexed and separated; the speculum is passed and held in position with the left hand. The tampon is then taken by the right hand in a pair of long forceps,—those usually called uterine dressing forceps,—and passed up to the pouch-like cavity between the cervix and the posterior vaginal wall. The speculum is withdrawn, and the ends of string looped together and laid just inside the vagina, where they will not be soiled by urine, etc. A record must always be made on the chart of any tampon inserted in the vagina; if more than one, or a kite-tail tampon is used, the number must be noted and carefully counted on withdrawal. The withdrawal also should be noted on the chart. The withdrawal is done by gently pulling on the strings, and presents no difficulty. If the tampon is for continuous treatment it is changed daily, and usually given in connection with a daily douche.

To Pack a Vagina.—This is not often left to a hospital nurse unless in small hospitals, where there is no resident medical staff. She should, however, be taught how to do it in case of just such circumstances. Under strict aseptic precautions the speculum is passed, the patient lying on her back in a good light, with the knees flexed and separated; a long strip of sterile gauze or a narrow gauze bandage is then packed into the space between the cervix and vaginal walls, using a pair of uterine dressing forceps and playing out the packing inch by inch. The rest of the cavity is then packed, withdrawing the speculum gradually. If more than one strip is used, the number must be recorded on the chart and counted when they are removed. If, on removal, any odor is noticed on the packing, it should be reported at once, when an antiseptic douche will generally be ordered. It should not, however, be given without special orders; the conditions

which necessitate packing would frequently not be benefited by the relaxation of the parts by douching.

CATHETERIZATION

A *catheter* is a slender hollow instrument of small caliber, open at either end, used in the treatment of certain tube-like passages in the body or of the cavities to which the passages lead. The hollowness of the instrument permits the evacuation of the contents of the cavity, and of the introduction of certain forms of treatment, such as douching, etc.

The catheters in most common use are those for introduction into the bladder through the urethra, and are what are implied when the word catheter is used unqualifiedly.

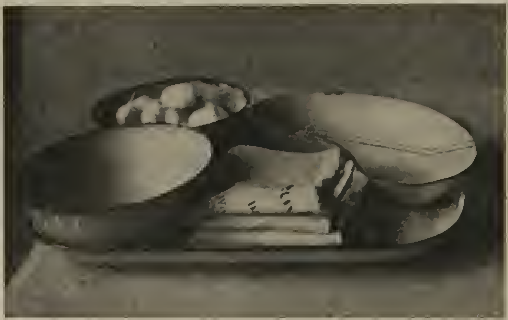


Fig. 30.—Tray with necessaries for catheterization.

Those used for a female patient are made of glass, silver, soft rubber, or hard rubber. The glass catheter is generally preferred, being easily cleaned or sterilized and inexpensive. It is about 6 inches in length and $\frac{1}{8}$ inch in diameter; the tip is solid, rounded, and slightly bent, with an opening or eye on one side. If a less rigid instrument is desired, as after an operation on an adjacent part, the soft-rubber variety is substituted.

Soft-rubber or gum-elastic catheters are about 12 inches long, and come in various sizes; the sizes are indicated in numbers printed on the catheter. Three scales of numbering are in use—American, English, and French; it is

important in ordering catheters to mention which scale is intended, as each is different.

A pupil should not be trusted to pass a catheter until she has had some instruction in the principles of asepsis, and been carefully taught the technic of this particular process.

It is recommended that a list of the articles required for catheterization with simple directions for the technic to be observed should be written down and hung in some readily available position (Chapter XIV). Time is saved if a tray is kept in readiness with all the articles necessary. Such a tray should contain:

2 towels, 6 gauze sponges, 1 small flat bowl (to receive the urine) } Sterile, in sterile wrappers.
1 bowl of hot boric lotion (2 per cent.) for cleansing the parts.
2 glass catheters (boiled five minutes and placed in the boric lotion).
1 large bowl or graduate measure of sufficient capacity to contain all the urine.

A bowl of hot antiseptic lotion (bichlorid of mercury, 1 : 2000, etc.) must also be prepared, in case the nurse accidentally breaks the technic.

The hands are prepared according to the ward formula (p. 484, formula B, in ordinary circumstances); gown and gloves are not usually required.

Before cleansing her hands the nurse prepares her tray, unpins the sterile wrappers, and places everything in readiness by her patient's bedside; if she works alone, she must also place her patient in position, covering her temporarily with a single sheet, which the patient can herself usually turn out of the way when the nurse is "clean," the sheet not being, surgically considered, "clean." A second nurse, when available, should, for the patient's comfort, carry out this part of the technic so as to avoid the necessary waiting.

The patient lies on her back, with the knees drawn up and separated; the night-dress is rolled up round the waist, the heavier bed-clothes, for convenience, turned back over the feet. The covering sheet is turned back to the knees just sufficiently for the necessary exposure. The

sterile towels are arranged one across the pubes, one on the bed below the vulva; the small sterile basin is placed close to the vulva, to receive the urine, which is emptied, as required, into the larger bowl. The sterile area must be kept sterile during the entire proceeding.

To pass the catheter the nurse stands on the right of the patient; passing her left hand between the knees, over the pubes, she separates the labia and with her right hand thoroughly cleanses the parts of all secretion, using the sponges wrung nearly dry in the hot boric lotion.

The opening of the urethra (urinary meatus) is seen as a small round depression or "dimple" with slightly raised edges immediately in front of, or, as the patient lies, above, the larger opening of the vagina.

The catheter is taken in the right hand and introduced into the urethra, pushing it gently forward a few inches until the urine flows, and no further; no force must be used.

When the urine stops, the catheter should be withdrawn slightly, when the flow will probably begin again; as the bladder empties the level of the urine may be lower than the edge of the catheter, so that the first stopping of the flow does not necessarily mean that the bladder is quite empty.

When no more urine comes, the catheter is withdrawn, keeping the finger over the free end of the catheter in order not to lose the last small quantity remaining in the catheter: being the last left in the bladder, it is often of special diagnostic importance.

The vulva is then once more sponged and dried with one of the sterile towels, after which the nurse rinses and dries her own hands and arranges her patient comfortably.

When catheterization is ordered for the relief of an over-distended bladder, the entire quantity should not be withdrawn at one time, some being left in the bladder, which is, if necessary, removed later by catheter. The tumor formed by a distended bladder may be observed through the abdominal wall. When empty, the bladder lies behind the pelvic bone.

The greatest care must be taken to keep the catheter clean during the entire proceeding; that the catheter should

be clean and strictly sterile is the most important part of the technic. If it becomes soiled with blood or vaginal secretion, it is not enough to rinse it clean in solution: the catheter must not be used unless resterilized by washing and boiling. It is, for this reason, a wise precaution always to prepare more than one catheter each time. Where any vaginal discharge is present, a gauze sponge must be held over the vaginal orifice during the whole operation.

After an operation on the perineum or adjacent parts nurses are usually required, in passing the catheter, to wear a gown and gloves, and the hands are prepared by a stricter formula (p. 484, formula A). An extra packet of sponges and a perineal pad should then be prepared. In these circumstances a soft-rubber catheter may be preferred to the rigid glass catheter. A rubber catheter requires to be lubricated with a very little sterile oil; with a glass catheter it is sufficient to wet the catheter in the boric solution.

The nurse should observe the stream of urine closely. If blood, pus, or any sediment is present, it is of importance to know if such was mixed with the entire quantity of urine, or was present only at the beginning or only at the end of the catheterization. She should observe whether the urine was passed clear or cloudy, and whether it changed in any way on becoming cool. (See Urine.) She may be directed to keep the first or last of the flow separate from the rest of the urine, in which case the desired specimen is passed from the catheter directly into a sterile test-tube, corked at once with sterile cotton. If a specimen of the urine is required for examination, a sufficient quantity (6 ounces) is passed directly into a sterile bottle or jar and closely covered or corked with sterile cotton; a note must be made on the label that the specimen was obtained by catheterization.

Where strict aseptic cleanliness is observed, catheterization is followed by no untoward consequences. Carelessly performed, with impartially cleansed catheter or hands or imperfect technic, the simple process may be a source of infection by introducing germs or impurities into the bladder. The signs of such infection are *rigor*

(or shivering), followed by high temperature, alkaline urine, and the general physical symptoms of a septic condition. The *cystitis* or inflammation of the bladder thus induced may last many weeks.

A few patients are subject to shivering attacks of nervous origin after prolonged catheterization. Frequently this may be averted by covering the patient warmly during the operation and giving a glass of hot milk afterward.

Bladder Irrigation.—The same technic as above is observed in irrigating a bladder, and catheterization is always performed as a preliminary proceeding. Irrigation is most simply performed with the double catheter, a catheter, that is, having a double channel and double opening, each opening having an independent short arm. They can be obtained in glass or metal, glass being pre-

Fig. 31.—Double catheter for bladder irrigation.

ferred. To each arm a piece of tubing is attached, one connected with a douche-can or a funnel, the other reaching to a convenient receptacle for the return flow. The return tube is clamped until the quantity that can be retained without pain has been injected into the bladder. The quantity is usually about half a pint. Sterile water or boric solution, 2 per cent., is generally used, at a temperature of 100° to 110° F., and 1 or 2 pints given at a time. The catheter must be filled before insertion and the fluid run off it until it runs hot. The douche-can should not be elevated more than two feet.

When a double catheter is not attainable, the funnel and tube may be used. About half a pint (8 to 10 ounces) is injected first; the tube is then lowered, and *half the quantity* siphoned off; injections of 4 or 5 ounces are repeated and siphoned off until the bladder is sufficiently

irrigated. In order to keep the tube filled with fluid it must be carefully pinched between the siphoning and the injection, but even with this precaution, it is difficult to avoid introducing air into the bladder unless the catheter is reinserted each time, which is obviously undesirable.

The Guarded Catheter.—After operations on the bladder or adjacent parts, it is sometimes necessary to leave a catheter permanently in place. In order that it should not slip, a special rubber catheter may be used, made with an enlargement just below the eye, usually shaped either like an arrow-head or a button. To insert or withdraw such a catheter the enlargement is for the moment obliterated by stretching the upper part of the catheter tightly over a long dressing probe or similar instrument, and passing it while still stretched. As soon as the tension is removed by withdrawing the probe the shape is resumed. The catheter is connected by a glass connection tube with a piece of tubing, which may be inserted in a bottle tied to the frame of the bedstead; it is removed at least once in twenty-four hours, cleansed, sterilized, and reinserted. As the eye of the catheter may easily become blocked, especially after operations where small blood-clots may be present, it is always necessary in these cases to keep close watch that the urine is flowing regularly.

To pass a guarded catheter or to pass a catheter over a surface where tissues have been stitched requires a great deal of skill, and should never be intrusted to young, inexperienced nurses. All nurses should also be taught to pass the catheter with the patient lying on her side, a position which presents no real difficulties. Where a fixed position is necessary, it may be impossible to turn the patient, even for so short a time, on to her back.

After use, a catheter must be immediately washed under a running stream of *cold* water, since hot water would coagulate any albumin which might be present, then washed in hot soap and water, and boiled for five minutes; before use it is again sterilized by boiling. (See Care of Catheters, p. 462.)

The Male Catheter.—To pass a male catheter is not

taught to pupil nurses, and is never included in the duties expected of a nurse.

On the very rare occasions in which an emergency should force this duty on her, she should employ the same careful technic taught her in passing the female catheter. A soft-rubber catheter lubricated with a sterile lubricant is used. The penis is washed (boric lotion, 2 per cent.) and the foreskin gently pushed back. The glans and meatus are then cleansed. Holding the penis rather more than halfway between horizontal and perpendicular, the catheter is gently inserted and pushed forward. If resistance is met, as usually happens, force must on no account be used; if the catheter is held in position for a short time and again gently pushed forward, it will, in ordinary conditions, slip into the bladder. If it cannot be passed without force, the attempt must be abandoned; matters will not be improved, and serious harm is easily done.

LAVAGE

In certain conditions, such as in cases of poisoning, or in the treatment of some diseases of the stomach and for purposes of diagnosis, it becomes necessary to remove the gastric contents and thoroughly to irrigate the stomach. The process is known as lavage.

A rubber tube of fairly large caliber and a yard or more in length is used. The special tubes sold for the purpose are of non-collapsible soft rubber; the end for insertion is conical, with an opening in the center; the other is furnished with a funnel. The tubes come in several sizes, which are numbered according to French, English, and American scales, like the soft catheters. A mark 18 inches below the insertion end of the tube indicates the length to be swallowed. The operation is carried out most conveniently with the patient seated on a low chair, but in many circumstances the recumbent position is necessary and presents no real difficulty. If a lavage is given quietly and skilfully, there should be no mess; it is well, however, in case of accident to protect the clothing with a rubber sheet, and to have a second also on the floor. A bucket

is required to receive the contents of the stomach, and a pitcher of a suitable size for pouring with one hand contains the fluid for the lavage. The tube is moistened with hot water or lubricated with glycerin (oil is unpalatable), and passed to the back of the tongue. If the patient remains quiet and will help by swallowing, the tube then slides easily over the epiglottis into the esophagus by way of the pharynx and so into the stomach. From 18 to 20 inches of the

Fig. 32.—Lavage, first step. Introduction of tube (Crandon).

tube are sufficient to reach the stomach. Many patients, however, struggle violently, and to pass the stomach-tube requires patience and skill. If the patient is unconscious, the tube should be left in position a few minutes after passing, to make certain that it has not by accident been passed into the trachea, where, if the lavage was given, the patient would be instantly drowned. If the patient breathes naturally and does not become cyanosed, and if it is ascertained, by holding the tube against the cheek, that

no air is being breathed through the tube, all is well and the operation can proceed. To pass a tube into the trachea is an extremely difficult thing to do, and were it not that such accidents are on record, the warning would seem to have little practical significance. The danger, however, must not be overlooked. The funnel is held about one foot above the patient's head, and as much water is poured into the stomach as it will easily contain. This varies from ½ pint to 2 pints, according to the age of the patient;

Fig. 33.—Lavage, second step. Tube in stomach; wash-water being poured into funnel (Crandon).

a still larger quantity is used if the stomach is dilated. The funnel is then lowered over the bucket, and the contents of the stomach in this manner siphoned off. The process is repeated usually until the water is returned perfectly clear. In some cases of chronic gastritis or dilatation of the stomach several gallons may be used at one time.

In some chronic affections of the stomach lavage is given as a regular treatment; it should then be performed daily before breakfast. Warm sterile water is generally used for regular treatment, or warm normal salt solution. A weak solution of nitrate of silver (1 : 5000 to 1 : 10,000 of plain sterile water) is ordered in many chronic conditions. For acute indigestion bicarbonate of soda (30 grains to a quart of water) is efficacious. If the lavage is given for

Fig. 34.—Lavage, third step. Suction and siphonage (Crandon).

the removal of poisons from the stomach, the lavage will probably contain an antidote to the drug. (See Poisons, Chapter X.)

(For Test-meals, see Chapter VII, p. 218.)

It is a nurse's duty to see that all the details of a lavage are accurately charted, such as the amount used before returning clear, etc.; in cases of suspected poisoning the gastric contents must invariably be saved for inspection.

GAVAGE

Gavage, or forced feeding, is resorted to in those conditions when, from circumstance or existing impediment, a patient cannot be fed in the natural way: for example, in feeding insane patients who refuse their food, in tetanus where the jaws are locked, after some operations on the jaw, in feeding unconscious patients, and sometimes in cases of extreme weakness, where to feed otherwise causes a struggle exhausting to the patient. Where the stomach-tube can be passed, a short stomach-tube and glass funnel may be used, but usually nasal feeding causes less disturbance to the patient.

NASAL FEEDING

A soft-rubber catheter attached to a funnel, the most practical of which is the barrel of a large glass syringe, is passed through the nostril straight backward to the back of the throat, and thence to the esophagus and stomach. The catheter may be lubricated with glycerin or simply wet with water. When in position, a few moments are allowed to elapse until any reactionary retching induced has passed, and also to make certain the tube is in position, and the food in liquid form is poured down the funnel. The food should be given slowly, the flow being easily regulated by pinching the tube. Milk, eggs, thin strained broths, beef-juice, or beef-essences may be administered in this way. The feeding is generally repeated every three or four hours. After the food is administered the catheter is quickly withdrawn, unless, as may be ordered in certain conditions, the tube is left in position. When this is the case, a strand of silk is threaded through the tube and looped round the ear. To pass the tube for nasal feeding is not difficult, but must be done with watchful care. The tube is apt to curl on itself at the back of the throat; if the fluid is poured down while in this position, it escapes into the mouth, causing choking, gasping, and the consequent almost certain introduction of some of the fluid into the trachea. A sufficient quantity would drown the patient at once, but even a very small quantity has dangerous re-

sults. No digestion goes on in the trachea or lungs; food, therefore, that lodges in any part of the respiratory tract undergoes decomposition, which may result in septic pneumonia. The finger should be passed to the back of the tongue after the tube is inserted, to make sure it is in the right position.

In giving a feeding it is not necessary that the tube should reach as far as the stomach. If it is merely passed 3 or 4 inches into the esophagus, there is less risk of exciting regurgitation.

The possibility of passing the catheter into the trachea must again be borne in mind, as to give the feeding in this position would cause instant death by drowning. Unless unduly flustered by nervousness, it would be nearly impossible to overlook the symptoms enumerated above, caused by such an accident. The risk of accidents is lessened by turning the head during the entire process to one side, or, if the patient is in a chair, by keeping the head bent slightly forward.

With irritable, semiconscious patients in conditions of serious weakness nasal feeding is generally less exhausting to them than any other method of feeding. Especially is this the case with young children or infants too feeble to suck. In giving nasal feeding to an infant it should be laid across the knees, the head turned slightly with the face away from the nurse, and the tube introduced in the nostril uppermost.

In many people the bony cavity of one nostril is larger than the other; if any difficulty is encountered in passing the tube, it may be removed and inserted in the other nostril, and in most cases is then easily passed.

CHAPTER V

TEMPERATURE.—PULSE.—RESPIRATION.—CHARTS

TEMPERATURE

By the temperature of the body we mean its degree of heat. *Normally*, this is 98.5° F., that is to say, higher than the atmosphere in which the average human being can live with comfort. This temperature is maintained by the perfect balance between the heat-producing and heat-losing properties of the body. Heat in the body is the result of chemical changes in the tissues. The production of heat is increased by the digestion and absorption of food and by exercise. Heat is lost through the skin surface by evaporation, by perspiration, and through the lungs by expired air. Some of this loss is checked by clothing.

A deviation from the normal temperature means a deviation from the normal condition of the body, though in health there is a fractional degree of difference between the temperature taken in the morning and that taken in the evening.

Deviations from the normal temperature are described in the following terms:

Algid collapse,	below 95° F.
Collapse,	95°–97° F.
Subnormal,	97°–98.5° F.
Normal,	98.5° F.
Slightly raised,	99°–100° F.
Fever,	100°–103° F.
Pyrexia,	103°–106° F.
Hyperpyrexia,	106° F. and over.

The extremities of temperature, if maintained, are fatal to life.

The temperature in health is affected by age, temperament, and idiosyncrasy. In infancy the temperature is normally from one to one and one-half degrees above that of an adult, gradually decreasing as childhood progresses. In old age a subnormal temperature is common. Persons of an excitable temperament are apt to have a temperature higher than those who are not excitable. A few persons are met in whom the temperature is very easily upset, and these show a high degree of fever for slight causes. This may be idiosyncrasy, or the result of a previous illness associated with hyperpyrexia, such as sunstroke. Persons leading sedentary or confined lives usually show a lower average temperature than those who live out-of-doors or take much exercise. In health the temperature is elevated as a result of exercise, excitement, and the absorption of food; it is lowered during digestion and sleep, after perspiration, after cold bathing, and from the effects of starvation and exposure to cold.

The temperature may be reduced artificially by the use of certain drugs, known for this reason as the *antipyretics*, such as phenacetin, acetanilid, etc., and by the application of cold to the surfaces. Cold, we have seen, is applied locally in the form of ice-bags, ice-poultices, ice-compresses, and ice-coils, and generally by baths, sponging, ice-cradling, ice-sprinkling, rubbing with ice, by cold packs, and by enteroclysis of cold normal salt solution. The temperature is also lowered by large doses of alcohol, and frequently also after the use of morphin.

The temperature may be raised artificially by small doses of alcohol, by hot drinks, and by the ingestion of food, by the use of cardiac stimulants, such as atropin, strychnin, etc., and by external heat, as in the form of hot-water bags, hot foot-baths, hot mustard-baths, hot coffee enemata, hot enteroclysis, and the subcutaneous injection of hot sterile normal salt solution.

Certain diseases are characterized by a marked *rise* in temperature. Among the most important of these are the acute infectious fevers, acute inflammations, such as peritonitis and appendicitis; toxic conditions, such as septicemia, uremia, and ptomain poisoning; acute func-

tional disturbances, such as heart disease and nephritis; heat apoplexy, and, frequently, hysteria. Long-continued pain is also frequently accompanied by a rise of temperature. The temperature is subnormal in conditions of sudden loss of vitality, such as shock, and in chronic diseases which are accompanied by impaired vitality, such as chronic nephritis, some forms of heart disease, etc.; in conditions accompanied by unusual loss of fluid to the body, such as Asiatic cholera and severe hemorrhage; in anemia, jaundice, diabetes, and in many forms of mental derangement. It is subnormal during convalescence from diseases where the temperature has been high, and after a crisis. A condition of extreme low temperature accompanied by marked depression of vitality is spoken of as **collapse.**

After the temperature has been raised, it will return to normal in one of two ways:

First: By direct fall to normal or below in comparatively few hours, accompanied by a decrease in the pulse-rate and the number of respirations per minute, by a general improvement in the patient's condition, and, usually, by profuse perspiration (diaphoresis), and by the passage of an increased quantity of urine (diuresis); this is known as a **crisis.** Diseases in which the fever falls in this way are pneumonia, measles, malaria, and typhus fever. Erysipelas and influenza also frequently terminate by a crisis when uncomplicated.

A crisis must not be confused with a very serious condition in which the temperature falls suddenly, while the pulse-rate increases, and the patient's condition is alarmingly worse instead of improved. Such a fall is seen as a characteristic symptom in severe hemorrhages, in perforation, and frequently occurs immediately before death; it is always a grave symptom.

Second: In practically all other fevers the temperature declines gradually, taking several days to reach the normal, and maintaining, in its descent, the usual difference between the morning and evening temperature. Temperature falling in this way is said to fall by **lysis.**

Where the temperature rises *abruptly* at the beginning

of an illness, we say the disease is characterized by a *sudden onset;* where the temperature rises slowly from day to day, with morning remissions, we speak of the *onset* as *gradual.* The sudden onset is generally accompanied by rigors, or in children by convulsions or vomiting; the gradual onset by malaise, shiveriness, loss of appetite, and headache. Pneumonia is a good example of the sudden onset, and typhoid fever of the gradual onset, of fever.

The course of fever characterizing different diseases varies in three different ways. These are spoken of as *continuous, intermittent,* and *remittent* fevers.

In *continuous* fever the temperature remains at about the same elevation, with little variation between the morning and evening temperatures. The temperature in pneumonia is a good example (Fig. 35).

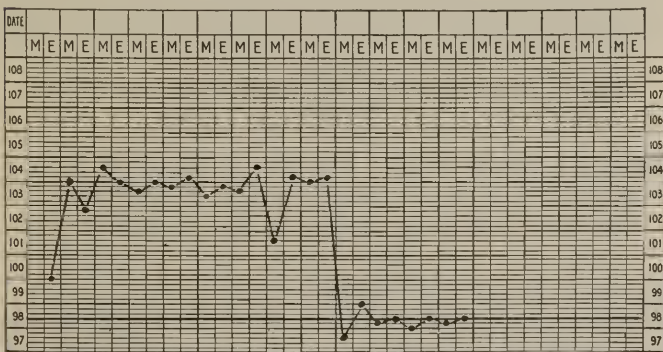


Fig. 35.—Temperature chart of lobar pneumonia (Paul).

In *remittent fever* the highest point in the daily temperature is followed by a steady fall or drop of two or more degrees. The lowest point of the temperature is, however, always *above normal.* The highest temperature-point in remittent fever is usually in the evening, the lowest in the morning. Usually the temperature in typhoid fever runs such a course (Fig. 36).

In *intermittent fever* the temperature, having mounted steadily to its highest point, falls again to normal or sub-

normal. The rise of temperature followed by the remission may occur daily (usually at the same hour) or after a

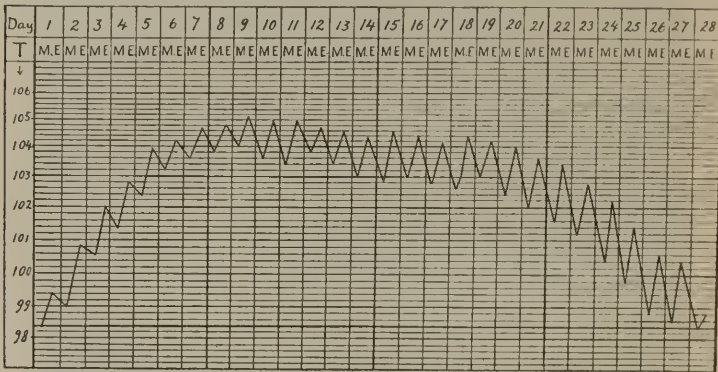


Fig. 36.—Temperature-curve in a typic case of typhoid fever (Register).

lapse of a regular number of days. Intermittent fever is characteristic of the common forms of malarial fever and of long-continued septic conditions, such as the later stages

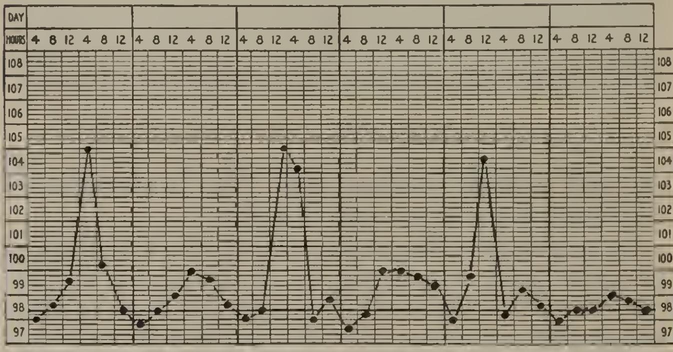


Fig. 37.—Temperature chart of intermittent malaria (tertian) (Paul).

of pulmonary tuberculosis. The rise of temperature is in the nature of a sudden onset, and the fall of a crisis.

The usual physical manifestations accompanying the sudden onset and the crisis are commonly present (Fig. 37).

Prolonged conditions of intermittent fever are frequently described as **hectic** fevers. There is usually a great discrepancy between the morning and evening temperature, the fall in the temperature being accompanied by profuse sweating. The condition is most frequently seen in cases of prolonged suppuration, such as the later stages of pulmonary tuberculosis (Fig. 38).

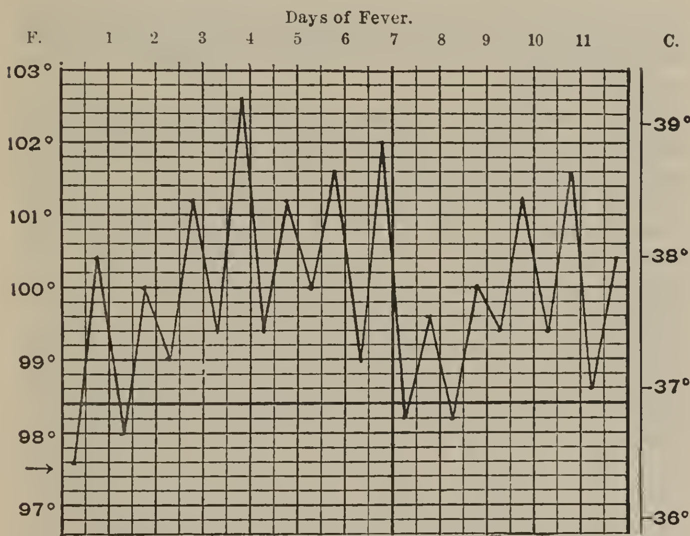


Fig. 38.—Hectic fever in phthisis (Sahli and Potter).

Diseases accompanied by a characteristic rise of temperature are roughly classed together as **fevers.** Besides the **onset** or **invasion** period, where the temperature rises, and the **decline,** where the temperature falls, either by crisis or by lysis, there is an intermediary period when the temperature remains raised for a certain time. This is known as the **fastigium** or the **stadium.** During the fastigium period all the physical manifestations characteristic of the special fever are intensified.

Clinical Thermometer.—The temperature of the body is ascertained by the clinical thermometer. This is the same as the ordinary atmospheric thermometer, with, for the sake of convenience, only those degrees, usually from 95° to 110° F., possible to the body temperature,

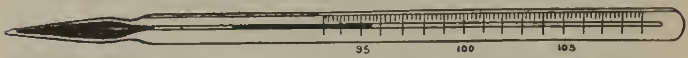


Fig. 39.—Clinical thermometer (Pyle's Personal Hygiene).

indicated. The scale is larger, the lines between the degrees being marked off into fifths, for a greater minuteness of record.

The Fahrenheit, Centigrade, and Réaumur Scales Compared.—In America, Great Britain, and the British colonies the Fahrenheit scale is exclusively used. It is said to have been preferred first by the army surgeons, who, in reading daily reports, found it a convenience that all fever temperatures were recorded by three figures, thus quickly catching the eye in long lists of names. On the continent of Europe the Centigrade scale is used, and in Switzerland the Réaumur thermometer may be met with.

In comparing these scales it must be remembered that while in the Centigrade and Réaumur scales freezing-point is at zero, in Fahrenheit it is placed at 32°; there is, therefore, an initial difference of 32° between the Fahrenheit scale and that of either of the other two. Further, there is a difference in the actual value of the degrees, a whole degree Fahrenheit equaling only $\frac{5}{9}$ the degree Centigrade and $\frac{4}{9}$ the degree Réaumur. Bearing these points in mind, the conversion from one scale to another is very simple.

To convert Fahrenheit to the Centigrade scale, 32 is first subtracted from the degree Fahrenheit, and the remainder is multiplied by $\frac{5}{9}$. To convert the Centigrade scale to Fahrenheit, the degree Centigrade is multiplied by $\frac{9}{5}$ and 32 is added to the sum.

Examples:

C. 40° $40 \times \frac{9}{5} = 72$ $72 + 32 = 104$—104° F.

F. 100·4° $100·4 - 32 = 68·4$ $68·4 \times \frac{5}{9} = 38$—38° C.

For the Réaumur scale 4 is substituted for 5, otherwise the calculation is the same.

In **taking the temperature** the thermometer may be placed under the tongue with the lips closed for five minutes, under the axilla or in the groin for ten minutes, or in the rectum for three minutes.

The mouth is usually the most convenient place for taking the temperature. It cannot, however, be used with very young children, where the patient is delirious, where local inflammations are present, or where, after certain operations or from extreme weakness, the mouth cannot be closed, nor should it be used immediately after eating or drinking.

Where the axilla is used, it should be wiped free from perspiration and converted into a closed cavity by crossing the arm over the chest, the fingers grasping the opposite shoulder. If the thermometer is placed in the groin, the area should be dry, and the thigh flexed and held against the abdominal wall.

The rectal temperature is best for infants, young children, and restless or delirious patients. The thermometer is oiled and inserted for about two inches, and held in place by a piece of cotton or a towel. This method cannot be employed after rectal operations or where there is disease or local inflammation of the rectum. It should not be employed where diarrhea is present, or where the rectum contains feces.

The temperature in the mouth is usually about half a degree higher than that of the axilla, and the temperature in the rectum again half a degree higher than that in the mouth.

A further method employed sometimes where absolutely accurate record is essential (as in collecting statistics), and otherwise impossible, is to have the urine voided over the bulb of the thermometer, the urine in passing being at the bodily temperature.

The thermometer must be washed in *cold* water after using, and kept in an antiseptic solution, from which it is rinsed in cold water and wiped dry before using again. It should be as scrupulously clean as a glass or a spoon.

Those used for rectal temperatures should be marked and kept apart from other thermometers. For hospital use a practical means of insuring care in this respect is to use as rectal thermometers those made with the bulbs of colored glass. These may be procured from A. Bayer and Son, 66 Beekman St., New York. The colored bulbs are also a convenience where a thermometer has to be kept strictly for one patient, as in an infectious case.

PULSE

By the term pulse we understand the beat or impulse that is felt on the expansion of an artery; it is produced by the *systole*, or contraction of the left ventricle of the heart. The condition of the pulse is an indication of the state of the circulation, and the condition, to a large extent, of the heart and blood-vessels. Of any one symptom, the pulse is probably the most important indication of the physical condition of the patient.

The arteries most conveniently used for taking or examining the pulse are those lying near the surface of the body and immediately over a bone, against which the artery can be compressed. That most often used is at the wrist, where the *radial* artery can be felt lying over the radius on the inner surface of the thumb side of the wrist. The *femoral* artery may be easily felt in the groin, where it slips over the rim of the pelvis. The *temporal* artery is felt against the bony prominence immediately in front of the external opening of the ear, and the *facial* artery on the edge of the lower jaw, usually on a line with the corner of the mouth. The femoral artery may frequently be felt when no pulse can be detected at the wrist, owing to the larger size of the vessel. The *common carotid* arteries on either side of the throat, although not lying over a bone, are valuable, as in cases of profound prostration the pulse may be felt in them after it has become imperceptible at points more remote from the heart.

Taking the Pulse.—The pulse is taken by placing two or three fingers steadily over the artery for not less than one minute, and alternately making and relaxing a mod-

erate pressure against the underlying bone. The body should be at rest at the time, and the arm, if it is the radial pulse, recumbent. An excitable patient should have his attention diverted and the examination be made for a longer period. The examination of the pulse should ascertain:

First: Condition of the artery.

Second: Amount of tension.

Third: Volume of the pulse.

Fourth: The number of beats to the minute.

Fifth: Their character, regularity, and irregularity.

In a normal pulse the artery should feel firm, round, and elastic, the blood-stream should fill it with moderate force, and the beat still be perceptible under moderate pressure from the fingers. There should be about 72 beats to the minute of perfect rhythm and regularity.

Instead of feeling firm and elastic, the arterial walls may be found hard and unyielding, twisted, and giving the impression of brittleness. To some extent this occurs normally in old age. It indicates a condition of arterial degeneration known as *arteriosclerosis*. This condition is also found as a result of disease, such as Bright's disease, etc., and is an important symptom.

Tension is caused by the resistance of arterial walls to the blood-pressure. By the degree of tension the force of the blood-pressure is estimated. Tension is said to be *high* when the artery remains distended between the pulse-beats, and *low* when between the beats it feels empty and is easily compressed. Tension may be altered by the size of the blood-stream, as after loss of blood from hemorrhage, by changes in the regularity or force of the heart's action, as in some forms of heart disease, and by changes in the arterial walls, affecting their elasticity. From the latter condition a high-tension pulse is found in those forms of chronic disease associated with *arteriosclerosis*.

A low-tension pulse is characteristic of conditions of low vitality, such as collapse, or the prostration occurring at the close of a long illness, such as typhoid fever.

Drugs which strengthen the condition of the heart raise the tension of the arteries, such, for example, as digitalis

The tension of a pulse may be lowered either by drugs such as nitrate of amyl and nitroglycerin, which reduce tension by dilating the blood-vessels, or by drugs which act as sedatives to the heart, of which aconite is an example. The tension of a pulse is estimated by the amount of pressure necessary to obliterate the beat.

Sphygmomanometer.—A special instrument for estimating the blood-pressure is known as a sphygmomanometer, of which there are several varieties.

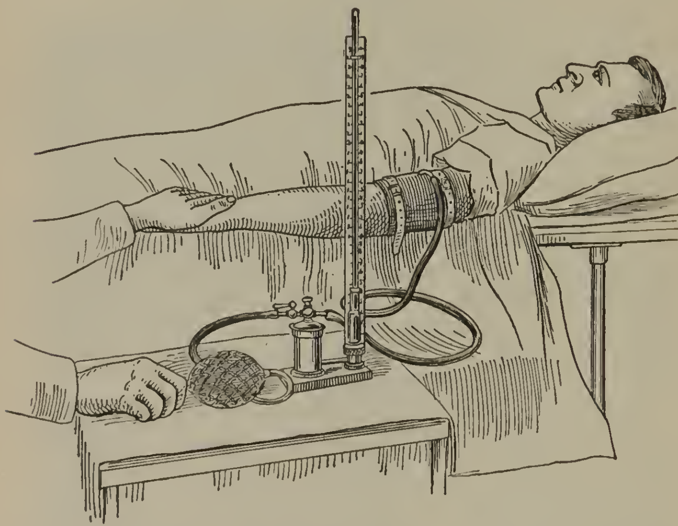


Fig. 40.—Technic of sphygmomanometry with the Stanton instrument (Morrow).

The instrument in general use at the present day consists of three parts: a dial with a mercury column like an atmospheric thermometer, the scale marked out in millimeters (*a*), a wide pneumatic cuff (*b*), and an air pump consisting of a double rubber bulb, the first (*c*) the pump, the second bulb (*d*) acting as an air-reservoir to equalize the air-pressure, and protected from overexpansion by a silk netting. The three pieces are connected together by tubing, so that when air is introduced by the pump, it is at the same pressure in every part of the apparatus.

The cuff, the inner surface of which is an air-bag, is secured round the upper arm and inflated until the pressure so produced on the brachial artery causes obliteration of the pulse at the wrist; at the same time the column of mercury is also raised by the air-pressure, and the amount of pressure necessary to obliterate the radial pulse can be read off on the scale in millimeters.

In " taking " the blood-pressure the fingers are kept on the radial pulse, while the air is pumped simultaneously into the cuff and the mercury chamber. When the pulse is obliterated, air is very gently allowed to escape, keeping the finger on the wrist and watching the column of mercury closely. On the first faint sensation of pulse under the finger, the height of the mercury is noted and is taken as the estimate of the blood-pressure.

The average blood-pressure in a healthy adult is between 120 and 140; it is lower in children and higher with increasing age. In diseases associated with high blood-pressure it may rise to between 200 and 300.

The instrument is valued as a more accurate means of gaging the blood-pressure than merely "taking" the pulse with the finger, especially in conditions where the blood-pressure may be subject to frequent and abrupt changes.

A pulse of high tension may be described as *hard* and *resistant*, a low-tension pulse as *soft*, or *compressible*.

The **volume** or size of the pulse is greater at the onset of fevers, in threatened apoplexy, heat-stroke, and other conditions usually associated with rise of temperature; and less in conditions of lowered vitality and great prostration. Where the volume is great, the pulse is spoken of as *full;* if at the same time accompanied by increased frequency of beat, it is sometimes described as *full and bounding*. This type is common at the beginning of feverish conditions. A pulse of lower than the usual volume is called a *small* pulse. After severe hemorrhage and in conditions of collapse it may be so small as to be almost imperceptible, the artery feeling like a little thread under the examining finger; such a pulse is known as a *thready* pulse. The tension of a pulse may be low, while the volume is large

and vice versâ. A hard pulse of very small volume is described as *wiry*.

The number of beats to the minute in a normal pulse is about 72. It varies, however, with age, sex, and idiosyncrasy. In a new-born baby the number is from 120 to 140 a minute; in young children below the eighth year, between 90 and 100; from the eighth to the fourteenth year, between 80 and 90, while in old age the pulse is usually below normal. In young children there is no difference between the pulse-rate of the sexes; in adult life a woman's pulse-rate is perceptibly higher than that of a man. Persons may be met with in whom, in an otherwise normal condition of health, the pulse-rate is abnormally quick or abnormally slow.

In health the pulse is accelerated by exercise, excitement, emotion, eating, the action of drugs which stimulate the heart, such as strychnin and atropin, and by small doses of alcohol. It is slower during repose and sleep, and in consequence of fatigue, exposure, or fasting. These conditions should be borne in mind in examining the pulse. Drugs which either quiet or strengthen the heart reduce the pulse-rate—such drugs, for example, as aconite and digitalis. An attempt to give a table of conditions stating the diseases in which the pulse-rate is high or low would be misleading. It would be difficult to make it sufficiently complete to be of value, and it must be remembered that in diseases the same conditions may be found that affect the pulse in health, and will have the same effect to a greater extent, the body being in a more susceptible condition.

Varieties of Pulse.—As a rule, the pulse rises with the bodily temperature at the rate of ten beats of pulse to one degree of temperature, though exceptions are often noted in diseases, such, for example, as typhoid fever, where the pulse is low in proportion to the temperature, or in scarlet fever, where the pulse is disproportionately high. We notice an increased frequency of pulse in all acute diseases, in almost all forms of valvular heart disease, in exophthalmic goiter, in many disorders of the nervous system, in reaction from conditions of lowered vitality, such as shock,

etc., and frequently on approaching death. We find a slow pulse generally where we find a lowered vitality, as in the convalescence following acute diseases, after severe hemorrhages, in many conditions of chronic diseases, and in depressed mental conditions. A slow pulse is usual in jaundice and in diseases of accidents causing pressure at the base of the brain.

The condition of persistent increased rate of the pulse is termed *tachycardia* (quick heart); the condition of persistent infrequency is known as *bradycardia* (slow heart). The pulse is said to be *slow* where the number of beats is considerably below normal; *quick* or *frequent*, where the pulse runs from 100 to 120; *rapid*, from 120 to 160, above which it is very difficult to count, and is spoken of as *running*. The terms *quick* and *frequent* are loosely employed in this way. Accurately, *quick* should be employed where the beat occupies a shorter time than usual; *frequent*, where the number of beats is greater in a given time.

Where each successive beat of the pulse is of equal value, the pulse is said to be *regular*. The regular pulse, as a rule, is accepted as a good symptom.

The more common forms of irregularity are as follows. The most common deviation from regularity is an *intermission* of a beat, either at regular or irregular intervals. While occurring in many diseases due to organic lesion, the intermediate pulse may also accompany causes of trifling significance, such as fasting, dyspepsia, the use of tobacco, and may frequently be observed in the pulse of young children or of aged persons during sleep, especially toward morning, possibly caused by the length of time they have been without food.

In the *irregular* pulse the pulsation may be unequal in time and in character. Some beats may follow each other with great rapidity, to be followed by slow beats and by a long intermission; at the same time the pulsation may be of varying force and volume, the latter condition requiring more experience to recognize than irregularity of time, which is easily detected. An irregular pulse is a symptom of serious disease, most commonly of some form of heart

disease. It may also be caused by an overdose of certain drugs, such, for example, as digitalis, which has a powerful effect upon the action of the heart.

The *dicrotic* pulse is a variation from the normal pulse frequently met with in conditions of prolonged fever and low vitality, such as typhoid fever or septicemia. It is characterized by a secondary impulse in each beat, following the first as a small wave may a large one. It indicates a relaxed condition of the arteries. The primary beat follows the systolic contraction of the ventricle; the secondary beat occurs after the closing of the aortic valves, and is a transmission of the impulse given to the blood-stream by the contraction of the walls of the aorta, an impulse which, though always present, is imperceptible to the examining finger in the ordinary condition of the circulation.

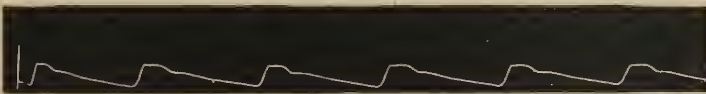
Where the dicrotic beat is strong, it is possible to mistake it for a second true beat; when any doubt exists, the heart-beats should be counted at the same time the pulse is taken.

Another variety of pulse, which should be recognized when met, is the *water-hammer* pulse, also known as *Corrigan's* pulse. It may be observed in the carotids as a sharp rising and falling of the artery. Under the finger it has the sensation of a sharp, powerful beat with a quick recoil. It is associated with disease of the aortic valves, producing a condition known as aortic regurgitation.

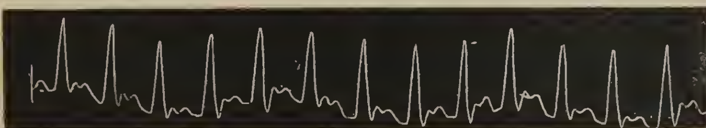
In persons suffering from severe anemia the pulse may be visible in the capillaries. In order to observe it the mucous membrane of the lip may be pressed with a glass slide until colorless, when the area may be seen under the slide to flush and pale rhythmically. It is also sometimes observed under the finger-nails. The condition is seen, as a rule, only in extreme cases.

In some rare conditions the pulse of the right and left wrist on the same individual differ. This points to some obstruction in the course of the circulation of one or other upper extremity; generally it is caused by pressure from an aortic aneurysm.

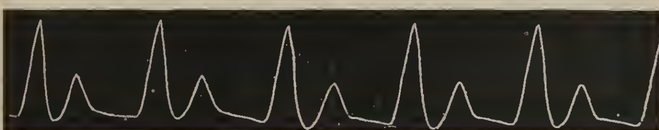
The Sphygmograph.—This is an instrument for recording graphically the different variations of the pulse. It is somewhat complicated. It consists essentially of a



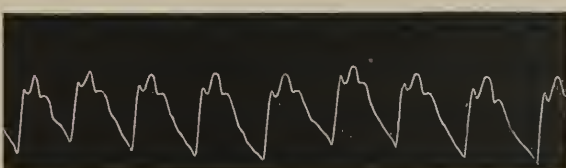
Pulsus durus.



Pulsus mollis.



Pulsus dicroticus.



Pulsus anacroticus.

Fig. 40*a*.—Sphygmograms of pathologic types of the arterial pulse. (Tracings by Dr. G. Bachmann.) (From DaCosta's "Physical Diagnosis.")

metal plate, fixed by a strap round the wrist over the pulsating artery; to the plate is attached a delicately adjusted needle in such a manner that the pulsations of

the artery are transmitted to the needle and traced by the needle on specially prepared black paper as a fine, white, wave-like line, corresponding exactly to the dilatation and contraction of the walls of the vessel. These traceries are known as sphygmograms, and offer a perfect picture of the pulse-wave. In a normal pulse the secondary impulse, noted above, is shown as a notch in the descending line; where the pulse is dicrotic, the notch becomes a well-marked second wave, often only slightly smaller than the primary wave. Many irregularities, difficult to observe with the examining finger, are clearly shown and easily studied when traced as a sphygmogram (Fig. 40*a*).

RESPIRATION

Of equal importance with the observation of the rate of the temperature and the pulse is the observation of the rate and character of respiration; that is to say, the manner in which breathing is performed.

The immense importance of breathing is realized on calling to mind that, through the act of respiration, the body is supplied with oxygen, without which life cannot be maintained even for a few moments, and that with the act of respiration the body parts with carbonic acid gas, a poison which, if retained, would be fatal to life. Any interference with the normal respiration is likely, therefore, to have serious results.

Breathing under normal conditions is an involuntary act, accomplished without exertion, sound, or pain, and accompanied with a rhythmic rising and falling of the chest-walls and the walls of the abdomen, due to the expansion and contraction of the muscles of respiration. In the act of respiration the lungs are passive, their part being to afford an enormous surface, where the fine capillary blood-vessels can ramify, and be brought into direct contact with the air of the atmosphere. The membrane of which they are constructed is so delicate that it is easily permeable to oxygen and carbonic acid gas, as are also the walls of the capillary blood-vessels. Air is drawn into the lungs by the mechanical enlargement of the cavity of the chest, just as a pair of bellows is inflated with air by pulling the surfaces apart; when the cavity is made smaller

again, the air is expelled. The muscles of respiration are the intercostal muscles, which alternately elevate and depress the ribs, and the diaphragm, which forms the floor of the chest cavity. In emergencies they are assisted by the muscles of the abdominal wall and by others. The mechanical act of respiration is controlled by nervous impulse, of which the center is situated in the *medulla oblongata*, often called, from the important nerve-centers there situated, the *vital knot*. The nerve-center is stimulated by the need of the body for oxygen.

Normal respiration demands a proper balance between the amount and quality of the air that reaches the lungs and the amount and quality of the blood circulating in the lungs. The balance may be affected by the changes in the atmosphere, as, for example, when the atmospheric air is deficient in oxygen; by alterations in the condition of the blood or in the circulation, as in anemia or heart disease; by obstructions in the lungs or air-passages, either from foreign bodies or from the inflammatory processes of disease; and by interference with the mechanism of respiration. The latter may be caused by paralysis of the muscles of the chest-wall, by rigidity of the abdominal walls, as in peritonitis, or by the pressure of fluid or a tumor from neighboring structures. In all these conditions we get the character and rate of respiration altered, and breathing an act attained by effort, sound, and pain or discomfort. At the same time every part of the body will also suffer from the deficiency of oxygen, and the poisonous effects of the carbonic acid gas, which has not been eliminated by contact with the oxygen.

The act of respiration is also altered by conditions directly affecting the respiratory centers, such as toxic conditions of the system and the action of certain drugs.

The **rate of respiration** may be determined by counting the number of respirations in the minute. The average normal rate of respiration a minute in the human being is reckoned as follows:

16–18 in the male adult.
18–20 in the female adult.
20–25 in young children.
30–35 in infants.

The ratio between respiration and pulse is commonly 1 in 4. In health respiration may be quickened by exertion, excitement, emotion, and by sudden chilling of the surface of the body, as in cold bathing. It is slower in repose, during sleep, and from the effects of fatigue.

The rate of respiration is increased in all diseases of the lungs and air-passages; usually in feverish conditions, in diseases due to toxins, such as the infectious fevers, uremia, etc.; in organic diseases affecting the circulation, such as heart disease and nephritis; in disorders in which the composition of the blood is altered, such as anemia; and in conditions where obstruction to the mechanism of respiration exists, as mentioned above. Respiration is also quickened by the action of drugs that stimulate the respiratory centers, of which atropin, the alkaloid of belladonna, is the most powerful known.

The rate of respiration is decreased in many conditions of injury to and disease of the brain, in most forms of coma, and from the action of those drugs that depress the respiratory centers, such as opium. Very slow respiration is *the most important symptom* in opium-poisoning.

Character of Respiration.—The respiration is described as *shallow*, when the volume of inspired and expired air is less than usual; *deep*, when it is greater than usual. *Shallow* respirations may accompany either rapid or slow respirations, though more usually the former. They may be caused by rigidity of the abdomen, as in peritonitis or abdominal distention; by pressure on the diaphragm from fluid, etc., or by a decrease in the available area of lung surface, as from inflammatory processes, consolidation, etc. Shallow respirations are also common in conditions of profound prostration, where the vital centers are greatly depressed.

Deep respirations are characteristic of many diseases of the brain, and especially of those conditions in which, either from disease or injury, there is compression of the brain.

Dyspnea means difficult breathing, and is a term used when the act of breathing is accompanied by conscious effort. It is not necessarily associated with pain, though such is frequently the case. Dyspnea occurs whenever

respiration is obstructed by any of the conditions mentioned above. Where dyspnea is so great that breathing is possible only in an upright position, the term *orthopnea*, upright breathing, is used to describe the condition. Pain associated with dyspnea is most marked where the act of breathing causes friction between sensitive surfaces, as, for example, in pleurisy, where pain in the side, increased by drawing a long breath, is a prominent symptom. The pain is due to the rubbing together of the inflamed surfaces of the pleura, the double covering that envelops each lung.

Dyspnea is usually accompanied by sound. In certain diseases the sound is so characteristic as to be diagnostic. Thus we have the *crowing* inspiration of croup, the harsh or *stridulent* breathing of diphtheria, the *wheezing* of bronchial affections, the *grunting* expirations of pneumonia; where the obstruction to respiration is great, and where, as in cases of great prostration, the body is not getting the oxygen it needs, the respirations may become *irregular* and *jerky*.

Where the act of inspiration is accompanied by a loud, snoring noise, the breathing is said to be *stertorous*. It is noticed in many forms of coma, especially in that of apoplexy, and is caused by the vibrations of the relaxed soft palate. *Sighing* and *yawning* in the course of an illness are frequently significant. Sighing is a common symptom in severe hemorrhages, and indicates that the body is not receiving sufficient oxygen; it is often accompanied by gasping and fighting for air, a condition known as *air-hunger*. Yawning is a symptom of syncope or faintness when occurring in conditions of shock, collapse, or hemorrhage; it is, on the other hand, considered as a favorable symptom and a sign of returning vigor if noticed during convalescence after a long illness.

A type of respiration known as *tidal* breathing, or *Cheyne-Stokes* respiration, is sometimes observed in very serious physical conditions. In a typical case the respirations begin quietly; each succeeding respiration is a little louder and deeper than the preceding one, until a climax is reached, after which the respirations as gradually subside; the wave of breathing is followed by a complete

pause of several moments' duration, following which the same process is repeated. Such breathing indicates failure of the respiratory centers, but how it is caused is not fully understood. It is always of grave significance, and in the course of acute illness is usually regarded as a sign of approaching death. It must not be confounded with irregular respirations, of varying rate and force, which do not occur rhythmically, and which are not followed by a distinct pause.

Mechanism.—Together with the rate and character of respirations the pupil should be taught to observe certain physical conditions which accompany the mechanical act of breathing. This will include observation of the shape of the chest, of the action of the muscles of respiration, and of the positions assumed by the patient.

In observing the mechanism of respiration it will be noticed that women have a tendency to use chiefly the chest muscles (*thoracic* breathing), and men and children chiefly the diaphragm and abdominal muscles (*abdominal* breathing). The use of deep breathing exercises aims at modifying this tendency.

In disease, the area used in the mechanism of breathing may be greatly modified, the greater part of the work being thrown on the unaffected areas; thus, when the action of the abdominal muscles causes pain, as in peritonitis, or their action is impeded, as by pressure from a tumor or the presence of fluid or gas in the abdominal cavity, we get the thoracic muscles only working—a condition spoken of as *restricted abdominal* breathing. In pleurisy and in diseases causing temporary or permanent consolidation of the lungs the affected side of the chest is noticed to expand less than the sound side. Where the bases of the lungs, for example, are solid, the upper part of the chest will do practically all the work, as in cases of emphysema. The term used for this condition is *diminished expansion.* In new-born infants it may sometimes be observed that one side of the chest-wall has failed altogether to expand, a serious condition, requiring resort to artificial respiration to rectify it.

The *position* of the *patient* with reference to his breathing is frequently significant of disease. In diseases of

the lungs patients have a tendency to lie on the affected side, thus giving the sound lung free play. Where obstruction exists in the air-passages, such as from asthma, patients cannot breathe in the recumbent position, and the same condition is observed in those forms of heart disease associated with venous congestion.

Where there is prolonged dyspnea from any cause, the ordinary muscles of respiration become inadequate for the work. To aid in overcoming this obstruction other muscles must be brought into play. The first to be observed will be the sternocleidomastoids, the muscles lying on either side of the throat, which have their origin in the clavicle and sternum and their insertion in the mastoid bone. By their action the upper part of the sternum and clavicle are brought forward and upward, thus aiding in enlarging the thoracic cavity. Next, the tiny muscles of the alæ, or wings of the nostril, will be noticed enlarging, to a slight extent, by their dilatation, the openings to the air-passages. When the effort of respiration is very great, the lower end of the sternum may be seen to be sucked in with each inspiration, forming an appreciable hollow in the chest at this point. These symptoms are of serious significance.

As a patient gets very weak the action of the sternocleidomastoid muscles has a tendency to draw the head backward, throwing the chin forward and upward with each inspiration, and giving to the head a rocking movement. This is usually a sign of swiftly approaching death, and is almost invariably present some minutes before death occurs.

The rosy color of the skin is dependent upon the oxygen taken up by the blood. An examination of the patient's skin will, therefore, show very quickly if respiration is failing to give the blood a sufficient supply of oxygen. Blood deficient in oxygen has a dark bluish hue. This discoloration will first be noticed about the lips; in other words, they become blue or *cyanosed*. In severe cases the cyanosis will spread to the extremities and be noticed at the tips of the fingers, under the nails, and may finally extend to the whole body.

It will readily be seen that a record of the character of

the respiration will hardly be complete without an intelligent observation of the above conditions.

As a record of the pulse and respiration can be achieved with very little, if any, disturbance to the patient, they can be made more frequently than that of the temperature, the taking of which in many instances is fatiguing, and sometimes impracticable. Conditions calling for frequent observations of the pulse and respiration are—during and following the administration of an anesthetic; in cases of shock, collapse, or hemorrhage; during and after a crisis—circumstances in which, it is obvious, the use of the temperature thermometer would be either impracticable or inadvisable. Where a record of the temperature is made, however, the pulse and respiration are recorded at the same time, their relation to each other being of great importance.

In counting the rate of respiration in nervous patients it is advisable to do so without their knowledge. In many cases the respirations can be counted by watching the rise and fall of the chest-wall. As it is impossible to maintain any but the natural rate of breathing for any length of time, a little patience is usually all that is necessary to take the respirations correctly. Where there is any doubt, the respirations should be counted while the patient is asleep.

CHARTS

Clinical charts are usually found more convenient than written records for following the course of an illness. A picture of the temperature day by day is by this means given at a glance, and if desired, the pulse and respiration and other matters, such as weight, amount of urine, etc., can be recorded in the same way.

The rulings on the temperature chart correspond exactly to the markings on the clinical thermometer, with a black line at the 98.5° of the normal temperature; cross rulings divide the chart into spaces, which may be made to signify days or portions of a day, as desired. If several spaces are taken for one day, as in the four-hourly chart, Fig. 41, a well-marked ruled line should

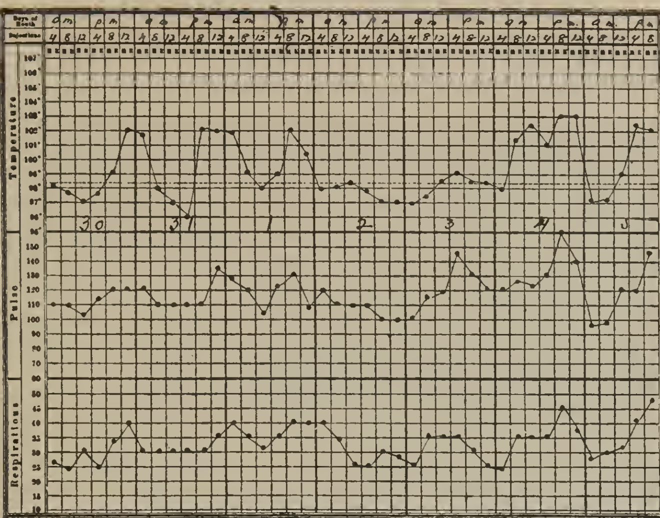


Fig. 41*a*.—Four-hourly chart of temperature, pulse, and respiration, medical case, showing one week. (Courtesy of Massachusetts General Hospital, Boston, Mass.)

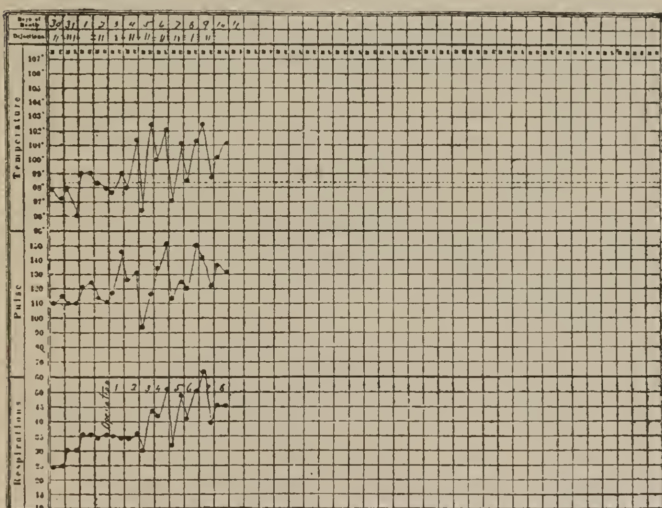


Fig. 41*b*.—Daily chart, surgical case. (Courtesy of Massachusetts General Hospital, Boston, Mass.)

divide the days between the last temperature taken on one date and the first after midnight on the following. A dot is made on the line corresponding to the height of temperature shown by the clinical thermometer, and the dots connected by a line drawn from one to the other. Besides the temperature rulings, there are spaces for the date, the day of disease, and for recording the pulse, respiration, amount of urine, and number of the bowel movements, with a marginal space for the name of the patient and other necessary details.

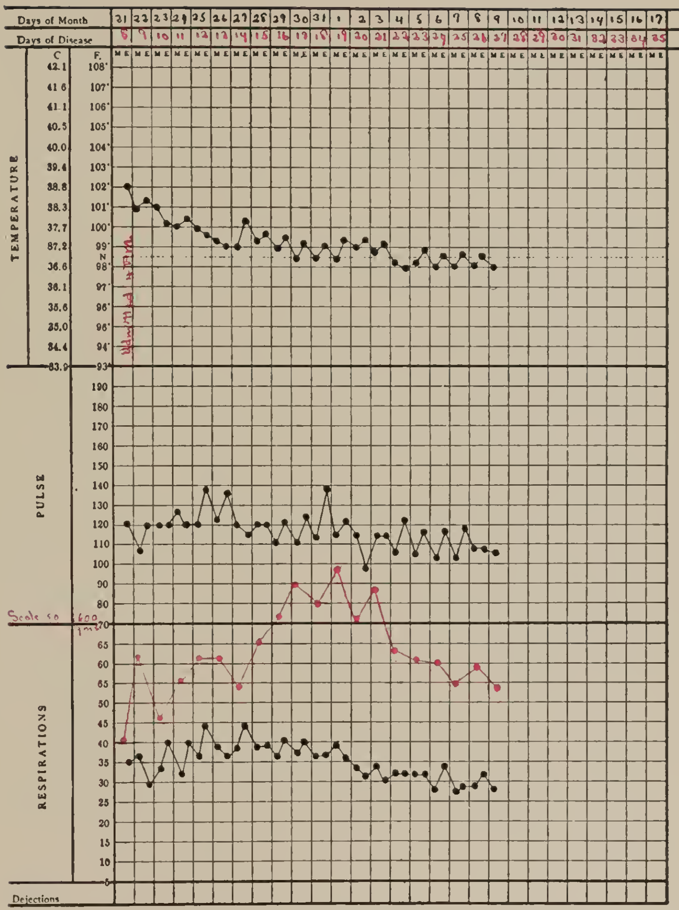
The keeping of a simple clinical chart presents no difficulties, and pupils should be accustomed early to keep them accurately and scrupulously neat.

Where the pulse and respiration, either or both, are recorded on the same chart, also by dot and line, it takes some practice to make the charts neat and clear. It is usual, for the sake of clearness, to use different colored inks for the tracings, the scale being drawn on the margin in the same color (Plate III).

It is often of value to show discrepancies between the normal ratio of temperature, pulse, and respiration in this manner. A clinical chart is issued with three separate rulings on each sheet, to enable the three records to be kept separately, and yet compared at a glance (Fig. 41, Plates II and IV). These are, on the whole, more easily kept neat and are quite as satisfactory as a clinical record. The ruled chart can, of course, be made to serve as a record of any facts connected with the disease which are capable of being measured; thus, on Plate II and Fig. 41c we have a tracing of the weight; on Plate IV, of the urine and blood-pressure.

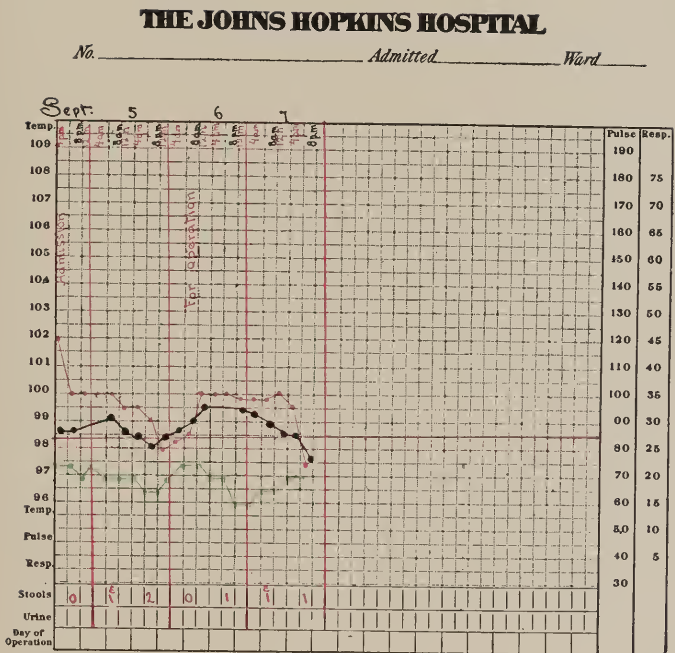
Special Chart.—Besides the clinical chart, in cases of serious illness it is usual to keep a special written record in which all details of the symptoms and nursing can be noted. Spaces should be ruled for the date, hour, the temperature, pulse, and respiration, the urine and bowel movements, and for the record of nourishment, medicines, and other treatment. A margin is left in which remarks, notes, and descriptions of symptoms, and so forth can be written down. These charts are a very great help in insuring an

PLATE II



Medical chart, showing baby's weight in red. Each space equals 50 grams. (Courtesy of Children's Hospital, Boston, Mass.)

PLATE III



Four-hourly chart, showing temperature in black, pulse in red, and respiration in green. (Courtesy of Johns Hopkins Hospital.)

PLATE IV

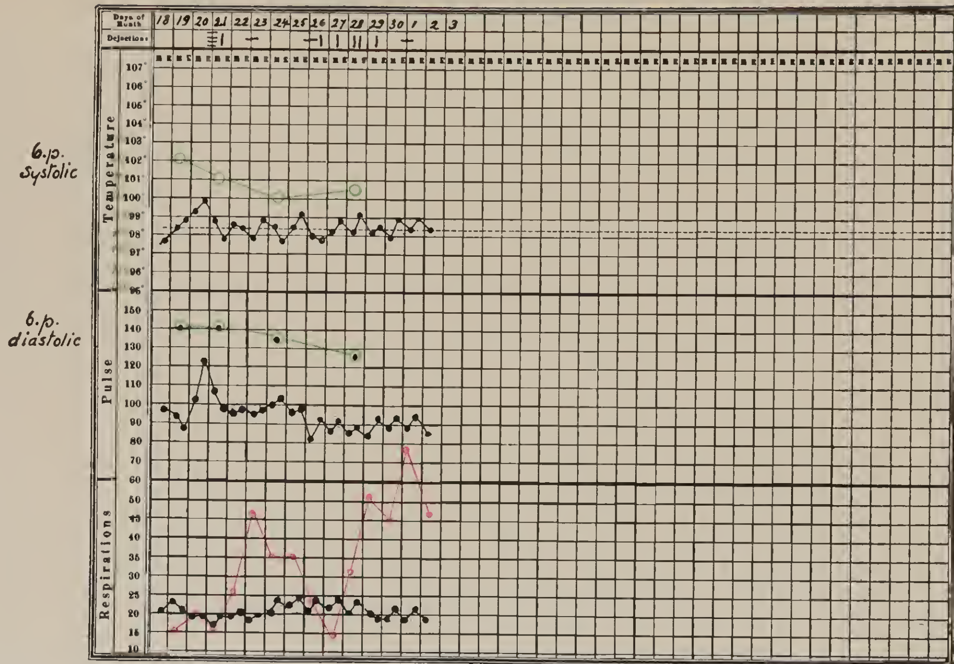


Chart showing, besides temperature, pulse, and respiration, urine in red and the blood-pressure in green. (Courtesy of Massachusetts General Hospital, Boston, Mass.)

accurate report of the case. At the end of every twenty-four hours a summary is made, giving the total amount of nourishment, stimulants, medicines, etc., the maximum

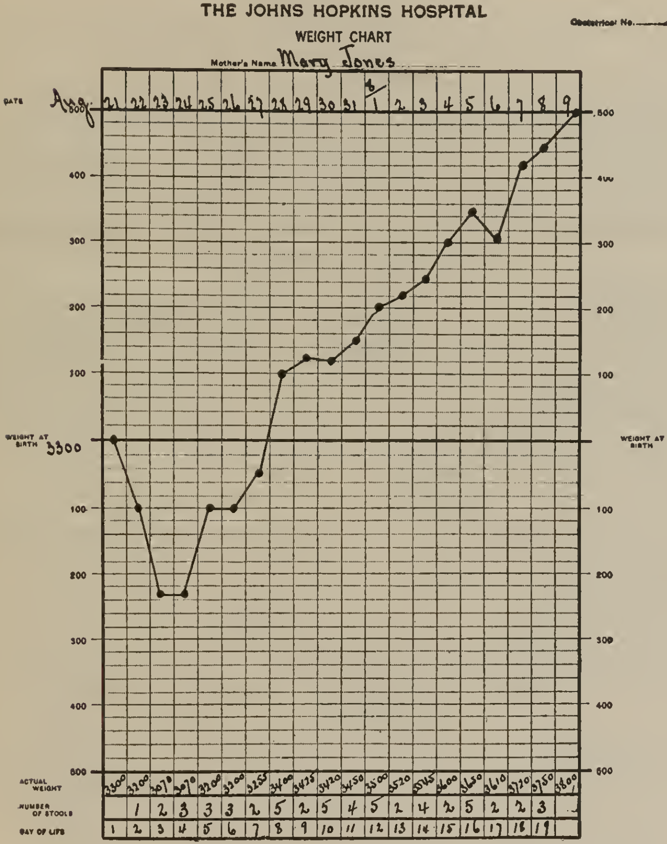


Fig. 41*c*.—Weight chart. (Courtesy of Johns Hopkins Hospital).

and minimum temperature, pulse, and respiration, and a brief epitome of the patient's condition during the twenty-four hours past (Fig. 41*d*).

Pupils should be given plenty of practice in keeping

these charts, especially in writing them neatly and in adding up the quantities of drugs which are so frequently

Polyclinic Hospital

Case ______________ Patient's Name ______________

Dr. ______________ Age ______________

Medical

HOUR	TEMP.	PULSE	RESP.	URINE	BOWELS	MEDICINES	FOOD	REMARKS
				Saturday		-June	20. 19—	
P.M.								
8	99	88	32			Theobromin	Custard	Back rubbed
						Sod. Salicyl grs x	Milk ℥viii	
9.				4 ounces				
11	99	84	36		i		Hot Cocoa ℥iv	Pt. slept quietly for half an hour
				24-Hour		Summary :	Midnight	
						Atropin Sulph gr 1/100	Custard ii	Chest painted with iodin
Highest	99	88	44			Pulv. digitalis grs iii	Milk O ii	Mercurial inunction
						Strych. Sulph gr 1/30	Broth O i	Cough troublesome, two attacks
				32 ounces	2	Theobromin	Cocoa ℥ x	of Dyspnœa
						Sod. salicyl. gr xx	Gruel O i	No sleep during day
						Nitroglyc. m xxiv	Orange albumen	Sleep during night three hours
Lowest	98	74	30				= 2 whites of eggs	i.e. 1½ hr. 1 hr. and ½ hours.
A.M.				Sunday		June	21-19—	
2								Sleeping, not disturbed
3				8 ounces			Cocoa ℥viii	Slept quietly half an hour
4	98	76	32					Back rubbed
6							Broth ℥viii	
							piece of toast	
8	98	84	32	2 ounces	i	Theobromin	Cup of tea with	Brown soft stool containing
						Sod. salicyl. gr x	cream & sugar	mucus.
10				10 ounces		Strych. sulph. gr 1/30	Orange albumen	Sponge bath
						Atropin sulph. gr 1/100	(½ white of egg) ℥ x	
						Pulv. digit. gr. i		
						Nitroglyc. m x		
12	98	76	32				Cocoa ℥viii	Mercurial inunction
								to left shoulder.

Fig. 41*d*.—Special chart. (Model used at Polyclinic Hospital, Philadelphia.)

given in fractional doses. Where the handwriting is very bad, pupils can usually be taught to print.

CHAPTER VI

OBSERVATION AND EXAMINATION

Subjective and Objective Symptoms—General Points to be Observed—Physical Examination—Inspection, Palpation, Auscultation, Râles, Murmurs, Percussion—Gynecologic Positions, Dorsal Recumbent, Dorsal or Lithotomy, Knee-chest, Sims', Trendelenberg—Vaginal Examination—Packing the Vagina—Uterine Examination—Examination of Bladder and Rectum—Examination of Eye, Ear, Nose, and Throat—Observation of the Skin: Abnormal Color; Eruptions; Other Alterations—Examination of Blood: Red Count; White Count; Varieties of White Cells.

One of the most important lessons that can be taught a nurse is to use her power of observation. The faculty of accurate observation, with a knowledge of the relative value of the facts observed, and the power of accurately describing the same, is probably of greater assistance in making a successful nurse than any other one thing. In most cases it is largely a matter of training. This must be done in two ways, by cultivation of the practice of observation in the pupil, and by accurate teaching in the matters to be observed and their significance.

The clinical examination of patients is at the present day a matter that may involve many complicated details in which the nurse may often be required to assist. In the present chapter we shall go over the principal common methods of clinical examination, with some brief notice of their use and significance.

Disease, or departure from health, is perceived, its nature diagnosed, and the necessary treatment determined, by the observation and examination of the person afflicted.

Disease is manifested by *symptoms* and by *physical signs.*

SYMPTOMS

Symptoms are divided into two groups—*subjective,* those complained of by the patient, and *objective,* those which may be noted by the observer.

Subjective Symptoms.— The most important subjective symptoms are pain, discomfort, sensations, such as nausea or giddiness, defects of hearing and vision, and hallucinations or allied mental conditions. To ensure accuracy, the report of the subjective symptoms should be given in the words of the patient, and particularly so in describing pain. The *locality* of the pain, its *character*, whether severe or slight, continuous or occurring at intervals; *sharp*, *piercing*, *dull*, *aching*, or *throbbing;* whether increased by deep breathing or coughing, or mitigated by change of position, and the *time*, *duration*, and *frequency* of the occurrence—are all points important to diagnosis and must be accurately noted. (See also p. 687.)

Where the patients are young children, unconscious, delirious, or in conditions of extreme weakness, an account of the subjective symptoms is obviously impossible to obtain. A diagnosis is then obtained by an examination of the *objective symptoms* and of the *physical signs.*

The **objective symptoms** include those due to the general condition of the patient and those which are the manifestations of the disease from which he is suffering.

The following list suggests the more important symptoms to be noted and which nurses in their work should train themselves to observe.

The apparent bodily strength, as shown in the ability to walk, stand, or sit.

The condition of the body, whether emaciated or plump; whether the muscles are flabby or firm.

The condition of the skin, whether dry, moist, or clammy; undue redness of any part; the presence and locality of sores, scars, or eruptions.

The color of the skin and mucous membrane, especially of the face, whether flushed, pale, cyanosed, or of an abnormal color.

The presence and locality, and, as far as possible, the character of abnormal prominences, swellings, or tumors; dropsy in any part, especially in the feet; enlargement of any joints; spots of abnormal tenderness.

The surface warmth of the body, especially of the extremities.

The temperature of the body, as shown by the clinical thermometer.

The character of the pulse and respiration.

The mental condition, whether quiet and placid, or restless, excited, talkative, fretful, irrational, or delirious, unduly depressed and melancholy, or unconscious.

The facial expression, which is frequently of importance, evincing pain, anxiety, apathy, ecstasy, or other emotions.

The odor of the breath: it may be heavy from gastric disturbances, offensive from the presence of decayed teeth, or fetid from disease, such as scurvy; alcohol and a few drugs impart a characteristic odor to the breath which may be of diagnostic importance.

The appearance of the abdomen: it may be distended with gas, enlarged by the presence of fluid or tumor, or hollowed out, as in conditions of great emaciation.

The appearance of the eyes, whether sunken or unduly prominent; any inflammation or discharge from the lids; unusual contraction, dilatation, or inequality of the pupils.

The condition of the nose and the character of any discharge.

The condition of the mouth, which is an important indication of many conditions; this will include an examination of the teeth, gums, and tongue. It should be noted whether the teeth are permanent or false, firm or loose, sound or decayed, clean or covered with sordes; whether the gums are normal, or swollen with a tendency to bleed easily. The tongue may be clean or coated; furred in the center or all over; dry, brown, or fissured, as in cases of profound toxemia; covered with patches, as in *thrush*, or ulcerated, as in *stomatitis;* or it may have something of the color and appearance of a ripe strawberry, a condition seen in *scarlet fever.*

The throat should also be examined, especially in young children, who do not complain of their troubles. Any redness or swelling and the character of any patches or the presence of discharge should be noted.

The gait of the patient, lameness, inability to place a foot on the ground, inversion or eversion of the foot,

dragging of the limbs, and inability to walk without looking at the feet, are all points of diagnostic value.

Certain symptoms are manifestations of certain conditions and should be accurately observed.

1. *Paralysis* in any part of the body, such as the limbs, part of the face, throat, or vocal cords, evinced by an insensibility to touch or an inability to perform their functions (p. 695).

2. *Tremor* or *subsultus:* a condition of general trembling, noticed at the onset of delirium tremens, and in some conditions of great prostration; irrational movements, such as picking at the bed-clothes (*carphology*), a symptom noticed in profound prostration, uncontrolled twitchings or movements, such as those seen in chorea.

3. *Persistent hiccough* (*singultus*), frequently due to gastric irritation, is also associated with certain brain diseases, and is a serious symptom in conditions of severe toxemia or great exhaustion (p. 701).

4. *Involuntary evacuations* which may be due to paralysis or imperfection of the sphincter ani, persistent diarrhea, or to the mental condition of the patient.

5. *Incontinence of urine*, which may be caused by an overdistended bladder, paralysis of the urethra or sphincters, or due to the mental condition of the patient.

6. *Vomiting.*—The time, frequency, and character of the act of vomiting. The vomitus itself should be inspected minutely, and the first vomitus of any patient should invariably be saved for examination (pp. 216 and 698).

7. *Convulsions.*—The time, frequency, and duration of the convulsions, together with the character of the movements, and any physical manifestations which accompany the attack (p. 663).

8. *Unusual cries*, such as the sharp, piercing cry heard in meningitis, the characteristic night cry common in hip-joint disease, or the wailing cry of an ill-nourished infant.

The above are all conditions that may be noticed by the nurse in her attendance on the patient and on her observation of which the doctor is, to some extent, dependent in making his diagnosis.

PHYSICAL SIGNS

Besides the subjective and objective symptoms just enumerated, the diagnosis of a disease depends also on an examination of what are known as *physical signs.* Physical signs are those manifestations of a departure from the normal condition of an organ detected in an examination of the organ by the eye, ear, and touch. The methods employed are known as *inspection, palpation, auscultation,* and *percussion.* While these examinations are carried out by the physician, an important part of a nurse's duties consists in preparing patients for such examinations, and in many instances she may be required to help.

Inspection, or examination by sight, is an observation of the appearance of that area of the body immediately covering the organ under examination; its object is to detect any departure from the normal size and aspect, and the presence of abnormal swellings, prominences, tumors, discolorations, or malformations. When the organ has a function with manifestations of movement, the observation of such movements is included in the inspection; for example, inspection of the heart will include observation of the position and force of the apex-beat against the chest-wall, and will show whether either position or force is changed by change in the position of the patient; inspection of the lungs will include observation of the movements of the chest and abdominal walls during respiration.

Palpation is examination by touch, and is performed by laying the open palm and fingers flat on the body over the organ to be examined. To some extent it verifies the examination by inspection. It further detects points of tenderness and soreness, and determines the character and condition of abnormal prominences, swellings, and tumors. For example, palpation will determine whether an enlarged abdomen is due to distention by gas, to the presence of a solid tumor, or to a collection of fluid in the abdominal cavity.

A special group of symptoms is also examined by palpation. These cause a sensation of tremor or *thrill* under the examining hand, some of which are normal and others abnormal and diagnostic of disease. Such a

tremor is spoken of as a *fremitus*, and is frequently likened to the thrill felt when stroking a purring cat.

A normal fremitus may be observed by keeping the palm on the chest during the act of speaking, crying, or coughing. This normal fremitus is modified, to a great extent, in disease, and others not normally present exist.

A *thrill* may be felt over the region of the *heart* in such disorders of the circulation as are caused by valvular heart disease or aneurysm of the aorta.

A peculiar vibration, known as a *friction fremitus*, is observed where two serous surfaces roughened by inflammation rub together, as in the case of pericarditis or of pleurisy.

The character of the fremitus and the point at which it is most distinctly felt are of diagnostic importance.

Auscultation, or examination by the ear, may be carried out by the ear alone held against the surface directly over the organ, or by the stethoscope. All those signs which manifest themselves by sound are examined by auscultation; such are the movements of air in the air-passages, or blood in the blood-vessels, and the grating sound caused by the friction of inflamed surfaces rubbing together. Abnormal sounds are heard in diseases accompanied by alterations in the air-passages or in the blood-stream in the blood-vessels. These are spoken of as *new* or *adventitious* sounds. If connected with the air-passages, they are known as *râles;* if connected with the blood-vessels, as *murmurs*. *Friction-sounds* not being perceptible in health belong also to the class of adventitious sounds. These *râles*, *murmurs*, and *friction-sounds* are very frequently referred to in describing diseases. Their significance, therefore, should be understood.

Râles.—When the air on inspiration or expiration passes through liquid secretions, as in the case of catarrhal or inflamed conditions of the lungs or air-passages, sounds of bubbling and crackling are heard through the chest-walls; these are known as *moist râles*, their variety being an important aid to diagnosis. A sound caused by a similar condition is heard in what is commonly known as the *death-rattle*, where the trachea becomes blocked with

mucus through which the air is breathed. The sounds of the râles are qualified by the thickness of the secretions and the size of the tubes over which they are heard. According to the sound, they are spoken of as *fine*, *coarse*, *crackling*, *bubbling*, or *gurgling* râles. Where the air passes through a tube of which the diameter is diminished by inflammatory processes, the abnormal sounds thus caused are spoken of as *dry râles*, and are *sibilant* or *sonorous*, according to the pitch. The râles are also grouped under the name of the areas where they occur. Thus we have *tracheal* râles, *bronchial* râles, and the *vesical* râles heard over the air-vesicles; the latter are also frequently called *crepitant* (crackling) râles, from the characteristic sound they produce.

Murmurs are due to changes in the directions of the blood-currents, usually caused either by obstruction of a valve, which impedes the flow of blood, or insufficiency of a valve, which allows the blood to regurgitate into one or other chamber of the heart; they may also be due to the presence of an aneurysm in one of the blood-vessels. They are audible over the area of the heart or over the course of certain blood-vessels, and are likened to the blowing sound made by a pair of bellows. Murmurs may also be due to conditions where the blood itself is seriously altered, as in anemia. These are spoken of as *hemic* or *inorganic* murmurs.

The peculiar sound of the murmur, the area over which it is heard, and the time of its occurrence, whether during or after dilatation or contraction, are all of diagnostic importance.

Friction-sounds heard through the chest-wall are caused by the rubbing together of the surfaces either of the pleura or of the pericardium, when they have been roughened by inflammation.

Percussion is a second method of examination by the ear. By placing a finger of the left hand directly over the point of examination and striking it lightly with the tips of the first or second fingers of the right hand, notes of varying pitch are produced, according to the density of the underlying structure (Fig. 42). By these means an area

occupied by an organ is mapped out and changes in its structure affecting its density are detected; the *resonance* of the lung is studied, and its *elasticity* or *resistance* determined.

The above brief description of the methods of physical examination and the significance of the physical signs so demonstrated are for the purpose of making more readily understood the characteristic symptoms and manifestation of certain diseases, and the aim and direction of the different methods of treatment. It is not, obviously, in any sense to be understood as a guide to an examination of a patient, such an examination being purely for the purpose of diagnosis, and not included in the duties of a nurse. Some of the terms, however, are so constantly referred to, both in practice and in all text-books which it may be desirable to consult, that an understanding of their meaning and significance is not only convenient, but necessary.

Fig. 42.—Percussion (DaCosta).

When the patient is not confined to bed, it is usually preferred to examine the chest with the patient either standing or sitting upright; in most hospital cases this is, however, out of the question. In examining the chest in front the arms are usually held hanging straight from the shoulder; in examining the side, the hands are crossed above the head; when the back is examined, the arms are crossed in front and the head bent forward. In a young child an excellent method of examining the back of the chest is as follows:

The child is taken on the left arm of the nurse, the buttocks supported by the arm, the front of the chest

flat against her breast. The head hangs a little downward over her shoulder, and may be held in place by her left hand. Usually the child feels comfortable and will remain still better in this position than in any other. To examine the front of the chest in a young child the child is held on the back across the knees, the head falling a little backward, and the arms held together above the

Fig. 43.—Listening to the back of a baby's chest.

head. If the arms are to be kept to the side, they may be pinioned in the following way:

Fold a hand-towel in half lengthways, and lay it cross-ways under the baby's back. Bring the ends up on either side between the arms and the chest, and tuck them in over the extended arms and under the back.

In all physical examinations the points essential for a nurse to consider are the following: The room must be

warm; the light good; the patient comfortable, never unnecessarily exposed, and kept comfortably supported without movement during the examination. During auscultation and percussion the room must be absolutely quiet. After the examination the patient should be warmly covered and induced to rest. If exhausted, some nourishment is given; in some cases a stimulant is ordered. For

Fig. 44.—Auscultating the chest, showing the arms fixed by the side

inspection it is obviously necessary to remove the garment. For the rest of the examination the covering is usually resumed or replaced by a towel or any covering of smooth material. When the chest is hairy, the nurse may be directed to wet the hair with warm water, as when rubbing against the stethoscope the hairs produce very definite sounds.

EXAMINATION OF SPECIAL ORGANS

In special cases it is necessary to examine, either by inspection or by digital examination, the cavities of the body, the vagina, the uterus, the bladder, or the rectum.

When an examination of a special organ is to be made, the patient may be asked to assume certain positions, according to the nature of the examination required. The positions are more especially applicable in gynecologic work. The usual positions are known by the following terms:

Horizontal or Dorsal Recumbent Position.—The patient lies on the back, one pillow only under the head. The legs are separated and the knees slightly flexed. The horizontal position is used for the ordinary digital examination. The examiner usually stands on the patient's right, in order to use the right hand for examination.

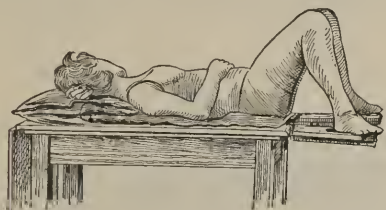


Fig. 45.—Dorsal recumbent posture (*American Illustrated Medical Dictionary*).

Dorsal or Lithotomy Position.—The patient lies on the back, either across the bed, the buttocks resting on the edge of the mattress, or, if on the examining table, with the buttocks brought to the edge of the table. A flat pillow is usually placed below the buttocks, in order to raise the pelvis. The legs are well separated, and the knees acutely flexed. To maintain this position it is necessary to support the feet and keep the knees immovable. An examination table is usually provided with "crutch and stirrup" for this purpose. The crutch is a rod adjusted to a socket at the lower end of the table (one at either side), to which a stirrup or foot support is attached. The stirrups are made of webbing, and are

hung from the crutch at the height convenient to support the foot. When the patient is in bed, she may be directed to place the heels on the edge of the mattress or on a small table or chair placed conveniently near on either side. The nurse, then, standing by the bed on the patient's

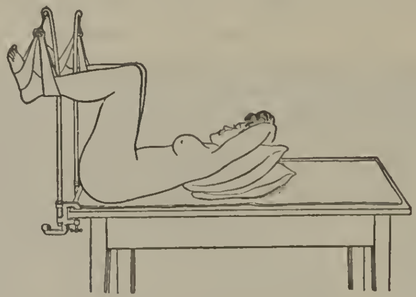


Fig. 46.—Lithotomy position (Ashton).

right side, holds the knees apart; the examiner usually sits on a chair exactly opposite the patient. Where it is necessary to control the movements of the patient, two nurses are needed, one on either side; the knee is encircled

Fig. 47.—Lithotomy position, with leg-holder applied (*American Illustrated Medical Dictionary*).

in one arm, the foot being held in the other hand. Other means sometimes used are to tie each ankle to the wrist on the same side with a wide piece of bandage; or a long wide bandage may be passed behind the shoulders and round the thigh, just above the knee (Fig. 47). This posi-

tion is used for examination and operations on the perineum, vagina, cervix (the neck of the uterus which hangs free in the upper part of the vagina), and uterine cavity, and for digital examination of such parts of the pelvis as can be felt through the vaginal wall; for examination of the bladder and rectum and for the majority of operations on the bladder and rectum.

Knee-chest, or Genupectoral, Position.—In this position the patient kneels on the bed or examining table and bends forward until the chest rests on the bed, the abdomen remaining unsupported. The head is turned to one side, resting on the cheek, and the arms are extended. A small pillow is allowed under the chest. The knee-chest position is very common in gynecologic work, not only for purposes of examination, but in order to overcome displacements

Fig. 48.—Knee-chest, or genupectoral, posture (*American Illustrated Medical Dictionary*).

and for the introduction of pessaries. Patients usually require to be taught the position, their inclination being to rest the abdomen against the flexed thighs. As the object most frequently is to allow the pelvic organs to fall forward, the object is defeated if the abdomen is supported. The knee-chest position is also a common one in making a rectal examination and in giving colonic flushing. The simple purgative enema is often more effectual if given in this position.

Sims' Position.—This is so called after a famous gynecologist who first employed it. It is also known as the *left lateral position.* The patient lies on the left side, the cheek resting naturally on the pillow (one small pillow only is allowed), the buttocks brought to the edge of the

bed, so that the body lies diagonally across the bed. She is then directed to place her left arm behind her back; this will turn the body with the right shoulder forward, so that the patient is lying partly on her chest, and the right hip is tilted more forward than the left. Both knees are drawn up at right angles to the body, and the right

Fig. 49.—Sims' position, anterior view (*American Illustrated Medical Dictionary*).

knee crossed over the left, so that it rests on the bed. The position is peculiarly favorable for obtaining a clear view of the cervix and dome of the vagina. With the body tilted in this position the abdominal viscera fall away from the pelvis, while the flexion and crossing

Fig. 50.—Sims' position, posterior view (*American Illustrated Medical Dictionary*).

forward of the right thigh exposes the orifice of the vagina. The Sims' speculum is passed, and the perineum held back; this exposes the vaginal cavity freely, and admits a certain amount of air, which distends the vagina and thus further facilitates the examination of the cervix and adjacent tissues.

The Sims position is especially used for inspection and for treatment of minor operations on the cervix and anterior wall of the vagina. With many surgeons it is a favorite position for the repair of vesicovaginal fistula (an artificial opening between the bladder and the vagina). In order further to keep the mouth of the vagina free, the nurse may be directed to elevate and support the right thigh. She may hold it in the required position, or, especially if the examination is a long one, place a double pillow or rolled blanket between the knees.

The above is the true Sims position; for a simple digital examination of the cervix, etc., where a picture of the parts is not necessary, many surgeons use a modification of the above, in which the left leg is fully extended; the position is otherwise the same. In this circumstance it is not necessary to expose the patient. For some examinations one or two pillows are placed below the left hip, thus raising the pelvis and tilting the right hip further forward: this is known as the *elevated Sims position.*

Trendelenburg position, also named after the gynecologist who employed it, is not, properly speaking, an

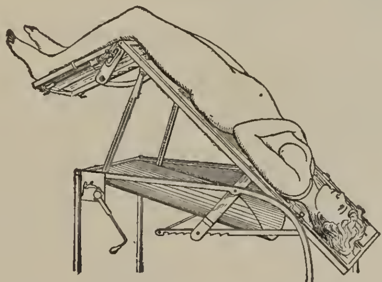


Fig. 51.—Trendelenburg position (Ashton).

examining position. It is at the present time the usual position in which abdominal operations on the pelvic organs are performed, and operating tables are usually made so that they can be easily adjusted to the required position. When this is not the case, the patient is placed in the dorsal position, with the knees flexed over the lower

edge of the table and the feet comfortably secured to the legs of the table. The head is turned to one side, resting on the cheek; the lower end of the table is then raised to the required angle, bringing the hips high above the shoulders. In this position the abdominal viscera fall toward the floor of the chest and away from the pelvis, leaving the pelvic organs more readily manipulated when the abdomen is opened.

If it is necessary to put the patient in the Trendelenburg position in the ordinary bed, a long-backed chair may be converted into an inclined plane by being turned upside down and laid with the front edge of the seat and the top of the back resting on the mattress, the chair-legs directed toward the bottom of the bed. The plane so

Fig. 52.—Improvised Trendelenburg position (Dickinson).

formed is comfortably padded with a pillow or a blanket. The legs are flexed over the bars of the chair, and comfortably secured to its legs, the patient lying along the back of the chair. The lower end of the bedstead may then be raised on blocks. In using the Trendelenburg position for any length of time it is usually considered desirable to change the angle from time to time. In the ordinary operating or examination table the adjustment is made by means of a cog-wheel, with the manipulation of which nurses should be made familiar.

More rarely the patient is examined *standing.* A stool is provided on which one foot is rested, the legs being separated as far as is comfortable. The patient supports herself by grasping the back of a chair (Fig. 53).

In all the above conditions no part of the patient is

exposed except that to be immediately examined. The night-dress should be rolled out of the way above the waist, and the heavier bed-coverings removed. In the horizontal position the sheet may be left over the patient, the sides and bottom untucked, and no exposure at all is necessary. In hospitals, for the Sims, knee-chest, and dorsal positions special examination sheets are usually provided, large enough to cover the patient, and made with an opening which can be adjusted over the area to be examined. Where these are not provided, a couple of sheets or draw-sheets, pinned together at the margin, leaving an opening at a suitable point, are practicable. In any circumstance two sheets, one above and one below, can, with a little ingenuity, be made to serve. The sheets should not be tucked under the mattress, as alteration in the position is thereby impeded.

Fig. 53.—Standing position (Ashton).

For the dorsal position stockings or leggings should cover the legs, and, if an examination sheet is not used, one sheet should cover the body to the pubes, while the second is placed below the buttocks; the sides are brought up on the outside and tucked round the thighs. If a douche is given in this position, a Kelly pad (p. 548) is placed below the buttocks, the rubber apron directed into a bucket on the floor.

In the standing position the skirts are removed and replaced by a sheet pinned round the waist in such a way that the opening is toward the examiner.

For a **vaginal examination** both rectum and bladder should be empty. A table is placed conveniently, provided with the following articles, ready sterilized, and laid on a sterile towel; a second sterile towel covers them until ready to be used:

One pair of rubber gloves.
Sterile lubricant.
Sims' speculum.
Uterine sound.
Uterine forceps or sponge-holder.
Applicators.
Tube of gauze packing.
One package of small gauze sponges.
One package containing a small quantity of absorbent cotton.
Basin of hot sterile water (100° F.).

Small bottles containing any applications desired, such as iodin, etc., may be placed ready on a tray containing also a sterile glass measure into which the small amount necessary can be poured.

A basin of antiseptic solution for the hands is also provided in case the technic is accidentally broken. The gloves are for the hands of the examiner.

The lubricant provided may be sterile vaselin or an emulsion of Castile soap. Many dispense with the use of lubricants entirely.

The *Sims' speculum* is a half cylinder made of plated metal mounted on a handle. It is used to enlarge the vaginal orifice by retracting the perineum, while its brightly plated surface acts as a reflector, increasing the light for purposes of inspection. It is usually advisable to have an artificial light and a head-mirror (see below) in readiness in case the available light is not sufficient. It is frequently the nurse's duty to hold the speculum in position. She should be careful to hold it immovable, as, if she changes the position, a different part of the vaginal wall will be held back and she may interfere with the object of the examination. Other specula sometimes used are in the form of complete cylinders of varying sizes, the inner surface of which is brightly polished. They may be made of metal, or more generally of glass, the outer surface of which is darkened and the inner surface silvered. If a nurse is directed to lubricate a speculum, she must be careful to lubricate only the outer surface, otherwise the reflecting inner surface is dulled.

The *applicators* are "*mounted*" with small strands of absorbent cotton. To do this a very thin strand, about two inches long and one-half inch wide, is taken between the finger and thumb of the left hand. The applicator is a small, roughened metal rod, mounted on a long handle. It is taken in the right hand, the tip placed between the finger and thumb of the left hand, and, by a quick rotatory movement of the right hand, the cotton is securely wound round the tip of the applicator. A little practice is necessary to perform this deftly. The applicator is then dipped in the required solution. A thick piece of cotton must not be used, otherwise it is apt to become detached and left in the cavity. Applications to the cervix, such as iodin, etc., are thus used directly on one spot without danger of dropping the application on other parts.

In order to pack the vagina the uterine forceps or sponge-holders are used. Sponges may be necessary to dry up secretions, small points of bleeding, etc.; the hot water is to warm the instruments before use.

The *uterine sound* is a long probe of polished metal marked off into inches or centimeters; $2\frac{1}{2}$ inches from the tip there is a slight enlargement. The sound is used for measuring the cavity of the uterus, the normal depth of which is $2\frac{1}{2}$ inches. The enlargement at this point shows quickly whether or not the cavity is normal.

The nurse's part in such an examination lies entirely with the patient. She may be asked to pour out some application, but must be careful to touch nothing sterile on the table.

In some cases the nurse may be required to prepare the *cervix dilators*. These dilators are small, solid instruments, usually either of silver or hard rubber, shaped like a pencil, slightly curved, about $3\frac{1}{2}$ inches long, and of varying diameters. Usually a set contains 12; they should be arranged on the table in order of gradation, convenient to the examiner's hand. Silver dilators are sterilized by boiling, and should be warmed before introduction; hard-rubber dilators would lose their shape if boiled, and are usually placed in alcohol (70 per cent.) at least half

an hour before use. A sterile lubricant should be provided, and the Sims' speculum, with which the vaginal orifice is held open during the dilatation.

The patient, for this process, lies either in the lithotomy position or the Sims position; if inspection of the part is also desired, the latter is usually preferred.

Bladder Examination.—For examination or treatment of the bladder the patient lies in the lithotomy position. Dilators for the examination of the bladder are straight, hollow, cylindric instruments, of varying diameter, usually of silver, which can be sterilized by boiling. The dilators, arranged according to size, are introduced in turn into the urethra; a sterile lubricant is usually required. The examination is made in a darkened room, with artificial light and head-mirror (see below); the polished inner surface of the dilators acts as a speculum, and helps to illuminate the cavity. A special dilator sometimes used is provided with a small electric bulb at the tip. When it is in place, the electric current is turned on and the interior of the bladder illuminated. This dilator is especially useful where it is desired to catheterize the ureters, the vessels which conduct the urine from the kidneys to the bladder.

To *catheterize the ureters* long, fine, filiform catheters are used, which must be carefully sterilized, usually in the autoclave. The patient lies in the lithotomy position; the urethra is well dilated, and the dilator kept in position while the catheters are passed; once the catheters are in position, the dilator is generally removed. As it is usually of the first importance to distinguish between the secretions of the two kidneys, one of the catheters should have some distinguishing mark, such as a piece of silk threaded through the open end. A note in *writing* should be made as to whether the marked catheter is passed into the left or right ureter. A couple of sterile test-tubes, also marked right and left, must be provided to catch the secretion. The open ends of the catheters are introduced into the respective tubes, which are corked with sterile cotton, packed lightly round the catheter.

For a **rectal examination** hollow dilators similar to

those for a bladder examination, but of a considerably larger size, are used. The patient, as a rule, is in the knee-chest position. Frequently applications are made through the dilators on fissures or ulcers that can be reached through the rectum. An artificial light and head-mirror are practically always necessary.

These examinations are always peculiarly trying to the patient, and are necessarily made more so if the nurse fails to have things ready, or to place the patient quickly and comfortably in the desired position.

Illumination of Cavities.—In conditions when it is desirable to get a clear picture of the interior of a cavity, such as the vagina, the bladder, the posterior nares, the posterior chamber of the eye, etc., a brighter illumination may be obtained by reflecting an artificial light from a small mirror directly on to the spot. The mirror in general use is most conveniently worn on the forehead of the operator, to which it is attached by a strap and buckle; it is usually known as the head-mirror (Fig. 55, p. 202). With the light in a suitable position an intensely bright light is focused from the mirror on to the area to be examined, and reflected back from the spot so illuminated. Under suitable circumstances sunlight may be used, but usually an artificial light is more satisfactorily adjusted. When an artificial light is used, the room must be thoroughly darkened; the light is held opposite the operator behind, and somewhat to one side of, the part to be examined, at such an angle that the rays are focused by the mirror and thrown directly on the desired spot. The head-mirror is provided with a minute opening in the center, through which the examination can be made if preferred.

EXAMINATION OF ORGANS OF SPECIAL SENSE

For the proper examination of the organs of the special senses a darkened room, with artificial light and reflecting mirror, is practically essential.

Examination of the Eye.—The eye is examined in order to determine irregularities of vision, such as myopia (near-sightedness), hypermetropia (far-sightedness), or astigmatism (defective refraction), and to ascertain the

condition of those parts of the organ of sight contained in the interior of the eye. This includes the retina, which is the expanded end of the optic nerve, forming a fine network round the internal chamber of the eye, and the crystalline lens, which is suspended immediately behind the iris.

Fig. 54.—Loring's ophthalmoscope.

The interior of the eye is examined through the pupil, the opening behind the transparent portion of the conjunctiva, which becomes smaller when exposed to the light, owing to the drawing together of the iris, or curtain of the eye. To overcome this, when careful examination of the interior of the eye is necessary, one or two drops of a solution containing a *mydriatic* are applied between the lids an hour or two previously. A *mydriatic* is a drug which has the effect of dilating the pupil by contracting and paralyzing certain muscles of the iris. The mydriatic usually employed is atropin (the alkaloid of belladonna); the usual strength used is either 2 grains or 4 grains to the ounce. Generally, 2 drops are ordered, one under the upper lid and one under the lower.

The effect of atropin is slow in passing away; usually the effect lasts the greater part of a week, during which time the eye cannot be used for reading, writing, and similar occupations. Where it is not considered necessary to keep the eye at rest for so long a time, homa-

tropin is used instead. Homatropin is a derivative of atropin, with a milder action and more quickly transitory effect. Some discomfort, usually a dryness of the throat or nose, is sometimes experienced by people as the result of atropin eye drops. This may be diminished by care in not applying more than the required number of drops, and by directing the patient to keep the nose held and the eye closed for a few moments after the application. The tears excited will then flow over the cheek, instead of into the nose by the lacrimal canal, and can be removed with a handkerchief. The patient sits opposite the operator, the light behind his head on the side of the eye to be examined. For accurate examination an instrument known as an *ophthalmoscope* is used. It consists of a small reflecting mirror with an opening in the middle, through which the examiner looks. The mirror is in an oblong metal plate fitted to a convenient handle; to the plate are attached small lenses of varying refractive power, which can be revolved in front of the small opening in testing the refraction of the eye. A crystal biconvex lens is also constantly used, either in place of a mirror, to illuminate the eye, or in testing the refraction.

In many cerebral conditions, and in accidents involving portions of the brain, an examination of the internal chamber of the eye is of considerable diagnostic importance. In these conditions the examination is, of course, made with the patient in the recumbent position.

Examination of the Ear.—The ear is examined for the purpose of obtaining a picture of the tympanum or drum, the delicate membrane lying between the external auditory canal and the chamber of the middle ear, upon the integrity of which we depend for our hearing. Small highly polished specula, usually of silver, in shape like a little funnel are used. The outer ear is drawn slightly upward and backward, in order to straighten the auditory canal; the speculum is placed in the opening, and illuminated with the bright light reflected from the head-mirror. Through the speculum applications can be made to the drum, and operations, such as puncturing the drum, per-

formed. The patient sits, of course, with the ear opposite the operator.

Examination of the Nose.—Similar small specula are also used in examining the nose--either the nostrils (nares) or the *posterior nares*, the small cavity lying between the nose and the throat. The specula dilate the opening and help to illuminate the cavity. In passing any instrument into the posterior nares the tip of the nose is pushed *upward* and the instrument passed *directly backward* into the small opening thus exposed.

Examination of the Throat.—For an examination of the throat a tongue depressor and applicators of a suitable

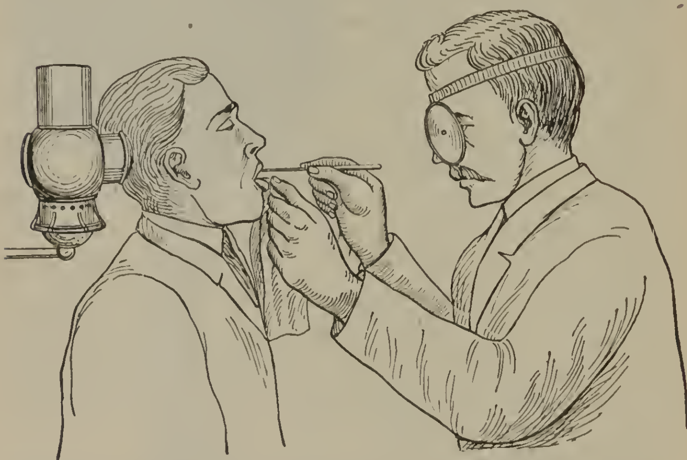


Fig. 55.—Laryngoscopy, showing the mirror being introduced, and also the relative position of the patient and examiner and the position of the light (Morrow).

size are necessary. The patient sits directly opposite the operator, his back to the light; an artificial light and head-mirror are always advisable. Tongue-depressors are flat instruments, made of metal or glass; any small flat body, such as a paper-knife or the handle of a spoon, serves the purpose. In hospital work small, flat pieces of smooth wood are commonly used, especially in the outpatient department, and can be discarded after use, if

advisable, without much expense. Clothes-pins divided in half are frequently used as cheap and convenient tongue depressors. Wooden applicators resembling long toothpicks are generally used, and burnt after use. The applicators are mounted with the strands of absorbent cotton as already described; they may be mounted and put up in packets of a dozen and sterilized like other dressings. A second small mirror mounted on a handle is passed to the back of the throat, in order to obtain a picture of the larynx (*laryngoscopy*).

Fig. 56.—Inflation by Politzer's method (Morrow).

For a throat examination a basin, towel, and glass of warm water should be at hand. In sensitive patients reflex vomiting may be excited by the pressure on the tongue or the touch of the applicator. Applicators are also frequently applied to the throat in the form of sprays.

The **Eustachian catheter** is a small, fine, hollow instrument, used to dilate the eustachian tube, *i. e.*, the passage leading from the back of the throat to the middle ear, or air-space immediately behind the drum. Generally, it is not lubricated, glycerin having too astringent an effect

upon the mucous membrane, and the taste of oil or soap being objectionable to the patient. It is usually wet with hot water before passing.

Politzer's bag is an apparatus frequently used in throat treatment. Its use is to dilate the Eustachian tubes by suddenly forcing through them a volume of air. It is a large rubber ball filled with air, and provided with a short nozzle of bone or hard rubber. The tip of the nozzle is introduced into one nostril; the patient is then directed to swallow a sip of water; as he swallows, the bag is sharply squeezed and the air prevented, by the act of swallowing, from escaping out of the mouth or entering the respiratory passages, is forced through the Eustachian tubes (Fig. 56).

OBSERVATION OF THE SKIN

Any abnormal appearance of the skin, general or local, is probably of diagnostic value.

Pallor.—Abnormal pallor of the skin and mucous membrane may be due to deficient circulation from disturbance of the heart's action, as in fainting, to contraction of the superficial blood-vessels, as in exposure to cold, to conditions in which the blood is deficient in coloring, as in the various anemias.

Cyanosis, or blueness of the skin and mucous membranes, results when the blood is not sufficiently oxidized. It may be caused by obstruction in the respiratory passages or organs (see *Respiration*), by conditions causing congestion of the venous circulation, as in *valvular heart disease,* or from failure of the nerve-centers controlling the respiration and the action of the heart, as in conditions of *collapse.* Cyanosis is relieved in several ways: (1) By the administration of oxygen; (2) indirectly by venesection, which relieves the venous congestion; (3) by the subcutaneous injection of one to two pints of normal salt solution, which increases the volume of the blood, thereby stimulating the circulation, and through the circulation, the vital centers.

Color.—Some diseases are characterized by changes in the color of the skin. In jaundice the tissues are stained *yellow,* from the presence of bile in the blood. The discolora-

tion includes the conjunctiva (the transparent covering of the eye), in which delicate membrane the yellow tinge first appears. Jaundice is a prominent symptom in the acute infectious fever known as yellow fever. Any conditions that may cause obstruction to the bile-ducts may be associated with jaundice, such as catarrhal conditions, inflammation or disease of the liver or gall-bladder, obstruction by gall-stones, pressure, as from cancer, etc.

Anemia.—*Simple anemia* is characterized by pallor of the skin and of the mucous membrane, especially noticeable on the lips and the conjunctiva. The grave form of anemia, known as *pernicious* or *malignant anemia*, is characterized by a lemon hue of the skin and mucous membranes, the eyes remaining clear. The discoloration is permanent and the disease is usually considered incurable.

Chlorosis, or green sickness, is the name given to a form of essential anemia occurring chiefly in girls and young women, in which the skin assumes a greenish hue. The disease yields to treatment, including a nourishing diet, iron, rest, fresh air, and good hygiene.

A temporary **local bronzing** of the skin, occurring as tawny patches, chiefly on the exposed surfaces of the body, is common in pregnancy.

Pigmented patches of a deeper shade of bronze on the skin and on the mucous membranes, especially of the mouth, is usually associated with Addison's disease, a fatal affection due to disease of the suprarenal glands.

Rashes or cutaneous eruptions are inflammatory conditions of the skin from various causes. They may be due to the action of toxins, to the use of certain drugs, to local irritations or inflammations, to animal or vegetable parasites, or to subcutaneous hemorrhages. Rashes may be *diffuse* or *circumscribed*, and present varied characteristic appearances, to describe which the following terms are used:

Erythema.—An erythematous rash gives the skin a bright red appearance, like a diffuse blush. In some instances, on close examination, the rash appears to be formed of minute scarlet points in close proximity. Erythematous rashes of this variety are known as *punctiform*.

They are characteristic of *scarlet fever, erysipelas, German measles*, and many *accidental* rashes.

Macule.—A macule appears as a spot not raised above the surface of the skin. A rash occurring in unelevated spots, either general or in isolated parts of the body, is described as *macular*. In inflammatory conditions the spots are red; in other conditions they may be brown (freckles or *lentigo*), yellowish, or white.

Papule.—A small solid spot elevated above the surface of the skin, usually pink or red in color, is known as a papule. Papules may occur in isolated areas, as in the *typhoid rash*, or distributed generally all over the body, as in the rashes of *measles, small-pox*, etc. In many instances papules become *vesicular* or *pustular*. Slightly convex papules are described as *lenticular*, from their resemblance to the form of a lens (example, the typhoid spot). (See also p. **713,** Rashes of Eruptive Fevers.)

Tubercle.—A solid elevation or patch, larger than a papule, is described as a *tubercle* or *nodule*. Characteristic tubercles are found in *syphilis, barber's itch, lupus*, etc. Tubercles vary in size from a " split-pea to a hazel-nut " (Gould).

A **vesicle** is a *blister*. An eruption occurring in small blisters containing clear fluid (serum) is described as *vesicular*. Commonly, the vesicle begins as a papule. The larger vesicles are described as *blebs*.

Pustule.—Vesicles containing pus are known as pustules. They usually occur first as papules or simple vesicles; the clear serum changes to a milky exudate, formed of serum and white corpuscles, which may shortly become true pus. Small-pox is characterized by a pustular rash. The vesicles in chicken-pox, more rarely the papules of measles, may also become pustular, especially if infected by scratching.

Wheals or Pomphi.—A wheal resembles a papule, but is evanescent and characterized by excessive itching. They may be red, or show a white papule on a reddened skin. A rash consisting of crops of wheals is characteristic of urticaria or nettlerash; wheals are also produced by the bites of insects.

Petechia.—Petechiæ are small purple points occurring under the skin, the results of minute hemorrhages. The rash is often described as a hemorrhagic rash. Such rashes are characteristic of *purpura, typhus fever, cerebrospinal meningitis,* and may also occur in severe forms of scurvy and the malignant varieties of scarlet fever, measles, and small-pox. A purplish discoloration of the skin in larger patches, caused by profuse subcutaneous hemorrhage, is known as *ecchymosis* (p. 599).

Scales.—A scaly or squamous eruption is due to the separation of the upper layers of the epithelium. Many forms of skin disease are characterized by the formation of scales; the formation, character, and distribution of the scales determine the diagnosis. Commonly, the scaling is associated with some inflammatory condition of the skin. The presence of flaky scales on the body may be due to desquamation following one of the eruptive fevers, especially scarlet fever.

In certain conditions the skin has a swollen appearance. This may be local, occurring in strictly circumscribed areas, or extensive, involving a large portion of the body, or generally distributed over all the body. Such swellings are described in the following terms:

Induration.—The tissues feel hard, solid, and resistant. Separate indurated swellings are commonly due to exudation from inflammatory processes. The swelling may become softer and gradually disappear as the inflammatory processes are absorbed, a process known as *resolution;* or *suppuration* may occur, and we speak of the mass *breaking down.*

General induration of the skin occurs typically in the disease known as *myxedema.* The appearance generally suggests dropsy, but the skin feels solid or resistant, and does not pit on pressure.

Brawny.—Extensive local indurations involving deeper tissues are spoken of as *brawny.* Brawny swellings are frequently due to cellulitis. A brawny condition of the extremities involving the muscles is common in *scurvy.*

Edema or Dropsy.—An edematous swelling is due to an

accumulation of lymph fluid derived from the blood-stream in the cellular tissues (p. 697).

A swelling due to edema may be readily indented by pressure, the indentations remaining after the pressure is removed. The skin is said to *pit on pressure*. Edema is a characteristic symptom in valvular heart disease, acute nephritis, and anemia.

In the rare condition known as **cutaneous emphysema,** *air* is present in the cellular tissues. The skin will pit on pressure, but the indentation disappears as soon as pressure is removed. On pressure, a crackling noise is heard over the area; the condition is due to an escape of air or gas into the tissues caused by the rupture of such an organ as the lungs or stomach, etc. The rupture may result from a wound or from disease associated with ulceration.

Hypertrophy and Atrophy.—Changes in the structure of an organ due to disease are called *morbid* changes.

Enlargement of any organ or tissue due to morbid changes is called *hypertrophy*. In some conditions we may have extensive areas hypertrophied. The immense swelling of the skin and cellular tissues of the lower extremities in *elephantiasis* is an example of hypertrophy.

A wasting of any tissue or organ resulting in a lessening of the size is described as *atrophy*. This may infect an entire limb, as in some forms of paralysis, where the processes of nutrition are less active than in other parts of the body, with the result that the limb appears shrunken and withered.

EXAMINATION OF THE BLOOD

The examination of a patient includes the examination of the excreta, vomitus, and sputum (see following chapter), and, usually, the microscopic examination of any abnormal discharge. This latter is accomplished by taking a culture (p. 504).

Under all circumstances, at the present day, it is also the custom to examine a specimen of the blood of the patient, its condition being very frequently of diagnostic importance. In many conditions and in diseases affecting

vitality the composition of the blood is altered. It may be altered in relation to the proportion of fluids and solids, or in the proportion of the different solids to each other; it may also contain extraneous substances, such as urea, bile, the bacteria of disease, or certain parasites.

The methods employed for examining the blood are the blood-count, the blood-smear, and in special cases the blood-culture.

The **blood-count** is used for the enumeration of the corpuscles.

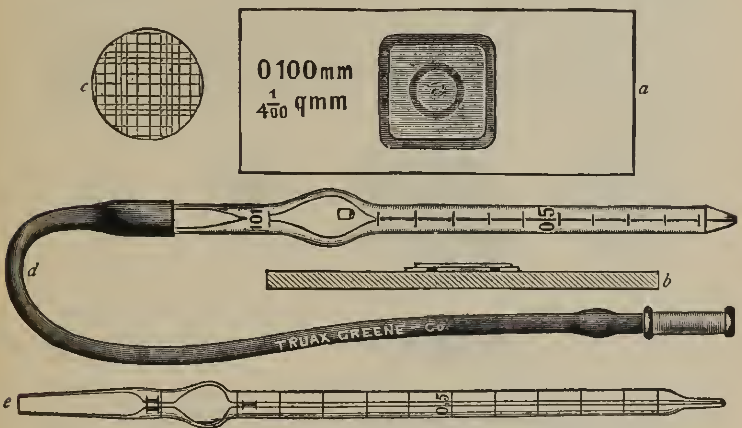


Fig. 57.—Thoma-Zeiss hemocytometer: *a*, Slide used in counting; *b*, sectional view; *d*, red pipet; *e*, white pipet.

A small area of the skin surface, usually the tip of the finger, is selected, washed with sterile soap and water, and sponged with alcohol. Antiseptics are not used, since, unless completely removed before the skin is pricked, they would coagulate the albumin in the blood. After cleansing, the spot is lightly pricked with a small sterile knife and a drop of blood drawn up into a special glass tube. This tube is known as a *melangeur*, and consists of a fine capillary tube, one part of which is expanded into a small chamber with a capacity of 100 cm. The drop of blood is sucked up to a mark on the tube; the point of the tube is wiped clean, and a certain quantity of a special

diluting fluid is drawn into the mélangeur, with which the blood is thoroughly shaken up. It is then ready for examination under the microscope. A special slide is used, usually that known as the Thoma-Zeiss hemocytometer. This is a glass slide, in the center of which a minute cell is ground out; the floor of the cell under the microscope is seen to be marked off into 400 squares of equal size. The diluted drop is placed in the cell, the corpuscles sink to the bottom, and, under the microscope, appear grouped in the different squares, where they can be readily counted.

A different diluting fluid is used according to whether it is desired to enumerate the red or the white corpuscles. In the latter case a fluid is used in which the red cells disappear.

Fig. 58.—Cells of blood: *a*, Colored blood-corpuscles seen on the flat; *b*, on edge; *c*, in rouleaux (Leroy).

We remember that in normal conditions the average number of red corpuscles (*erythrocytes*) in the blood is 5,000,000 to the cubic millimeter, and of white corpuscles (*leukocytes*) from 5000 to 10,000; in other words, about one white cell to 500 red cells. Certain transitory conditions may affect this proportion in health; in disease it may be considerably altered. In almost all forms of anemia, either essential or secondary, as following a severe hemorrhage, the red corpuscles are markedly diminished in number. Except in certain rare forms of anemia their shape is not altered. Red corpuscles are all of one variety, shaped like little biconcave coins; on the other hand, there are several forms of white corpuscles. They are easily distinguished from the red corpuscles by their lack of

color, their irregular shape, and the presence of a more solid central portion known as a *nucleus*. Unlike the red cells, the white cells possess a certain amount of independent activity, by which they can migrate from one part of the body to another and get outside the capillary blood-vessels. The movements are those common to protoplasm, of which substance the white cells are formed, and are called *ameboid* movements.

In normal blood four varieties of white cells are observed:

1. *Small lymphocytes*, small cells with a relatively large nucleus; they form from 25 to 35 per cent. of all leukocytes.

2. *Large lymphocytes*, similar cells, larger in size, with relatively smaller nucleus: form 5 to 10 per cent. of all blood-corpuscles.

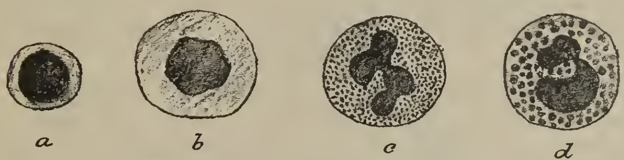


Fig. 59.—Various forms of leukocytes: *a*, Small lymphocyte; *b*, large lymphocyte; *c*, polymorphonuclear neutrophile; *d*, eosinophile (Leroy).

3. *Polymorphonuclear neutrophiles:* the nucleus is divided into two and sometimes more, and the basic structure, the *protoplasm*, is covered with granules: form 60 to 70 per cent. of the white cells.

4. *Eosinophiles:* so called from their affinity for eosin (an acid stain used in examining cells), resemble closely the third variety: form 1 to 4 per cent. of the white cells.

Other varieties may be found in certain diseases resembling one or other of the above, but with special characteristics. In disease the total proportion of white corpuscles in the blood may be decreased—*leukopenia;* or increased, *leukocytosis;* or one variety may be increased out of proportion to the others.

Leukocytosis occurs in a large variety of circumstances, the increase being especially in the polymorphonuclear cells. It occurs in all infectious diseases, such as pneu-

monia, scarlet fever, etc., with a few exceptions: in inflammatory or suppurative conditions, as, for example, in appendicitis or the formation of an abscess; in other toxic conditions, such as uremia and gout; following severe hemorrhage; as an accompanying symptom in perforation; in many malignant affections and other conditions.

Leukopenia is a special characteristic of a few infectious diseases, especially typhoid fever, malaria, and miliary tuberculosis. It is also observed in pernicious anemia and conditions of extremely low vitality.

Leukemia is a disease in which the number of white cells are *persistently* increased. In leukemia the *lymphocytes* are enormously increased, while in some diseases caused by animal parasites (filariasis, trichiniasis, etc.), in some skin affections (eczema, psoriasis, etc.), and also in other conditions, the *eosinophiles* are increased relatively or absolutely.

From the above it is easy to gather the diagnostic importance of an accurate count of the different white cells (usually called a differential count), especially during the course of a disease characterized by either an increase or decrease in the normal number. For example, in typhoid fever we look for a low count of the white cells; an increase in their number suggests a complication associated with leukocytosis, such as perforation or some inflammatory condition, and may be a very important aid to diagnosis where the physical symptoms are obscure. A low count of white cells in infections usually characterized by leukocytosis frequently is considered a sign that the patient's resistance is low, and the treatment is modified accordingly.

In studying the forms of the different varieties of blood-corpuscles the *blood-smear* is used.

Blood-smear.—To take a *smear* of blood the tip of the finger is prepared as already described, pricked, and a drop of the blood received on a perfectly clean cover-glass, which is immediately covered with a second, the corners of one glass being placed across the straight margin of the other. The two glasses are pressed together, causing the drop to spread evenly over the surface, and then drawn apart and dried in the air. Sterile forceps should be used

in the manipulation of the glasses, to prevent the risk of contamination from the touch of the fingers. Subsequently the smear is fixed by heat, and stained according to the requirements of the examination (p. 364).

The **blood culture** is used when, for diagnostic purposes, it is necessary to ascertain the presence of certain pathogenic bacteria in the blood. Under strict aseptic precautions an exploring needle is introduced under the skin

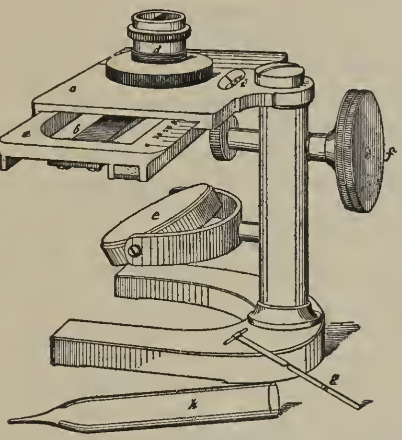


Fig. 60.—Von Fleischl's hemoglobinometer: *a*, Stand; *b*, narrow wedge-shaped piece of colored glass fitted into a frame, *c*, which passes under the chamber; *d*, hollow metal cylinder, divided into two compartments, which hold the blood and water; *e*, plaster-of-Paris plate from which the light is reflected through the chamber; *f*, screw by which the frame containing the graduated colored glass is moved; *g*, capillary tube to collect the blood; *h*, pipet for adding the water; *i*, opening through which may be seen the scale indicating percentage of hemoglobin.

directly into one of the veins of the forearm. The vein is previously distended by applying a bandage tightly round the upper arm. (See p. 505.) The blood, usually about 2 drams, is caught in a sterile glass tube and immediately transferred to tubes containing the necessary culture-media. The cultures are then developed in the laboratory and studied under the microscope. The puncture must be carefully dressed under aseptic precautions.

The blood from suspected cases of typhoid fever is put to a test known as the *Widal test* (described on p. 384). The blood for the test is usually taken from the tip of the finger, smeared on small pieces of specially prepared white paper, and allowed to dry in the air.

Hemoglobin.—The estimation of the percentage of hemoglobin (red coloring-matter) in the blood is also usually a matter of routine work. The hemoglobin is contained in the red corpuscles, to which it gives their red color. Various special instruments are used for estimating hemoglobin. In one very generally used (Fleischl's) the drop of blood, spread out on a small slide of clear glass, is compared under an artificial light with a piece of red glass graduated to the different shades of red given to the blood by the proportion of hemoglobin. The red glass is connected with a scale in such a manner that the different shades are registered as percentages, the 100 per cent. being the same shade of red as blood with 100 per cent. hemoglobin.

In private practice the *Tallqvist* method is frequently employed on account of its convenience. It consists of a booklet containing filter-paper and a colored plate in ten shades of red, representing the color of the blood with the percentages of hemoglobin from 100 to 10. The filter-paper is stained with a drop of blood and then compared with the colored plate.

HISTORY-TAKING

In the smaller hospitals, where there is no resident doctor, it frequently falls to the chief nurse to take the history of fresh cases, especially when the patients are children or in an unconscious condition, where all the information must be gathered from the friends. A systematic routine of questions is necessary, that no point should be overlooked.

First: The first details ascertained should be the name, age, sex, race, and social status (married or single) of the patient, his birthplace, occupation, and present address. For convenience in hospitals the name and address of his nearest relative should be also noted, and, if a non-resident

in the town, the name and address of an acquaintance resident in town.

Second: Next in order is his family history: whether his parents are alive, and if not, the cause and other details of their deaths; the number of brothers and sisters, and the enumeration of any illnesses to which they have been subject, and the cause of any deaths that may have occurred. The presence in the family of any manifestations of insanity, tuberculosis, cancer, or organic disease.

Third: Following the family history comes the former health record of the patient. He should be minutely questioned as to any former illnesses, especially the infectious illnesses common in childhood, and rheumatism, which is frequently followed by a tendency to organic heart lesions and other manifestations.

Fourth: The health record of the patient leads naturally to the history of the present illness. As far as possible this should be written down in the words of the patient, and considerable ingenuity must be exercised to elicit information without giving leading questions which may produce biased, and often misleading, answers. The date of the apparent onset and the symptoms first noticed must be first noted, then the progress of the illness and the order, when possible, in which divers symptoms have manifested themselves. Judicious questioning should elicit such facts as loss of sleep and appetite, cough, evening feverishness, attacks of shivering, excessive perspiration, and some description of any expectorations or vomited matter.

To take a history adequately requires practice, patience, and tact. A good history is, however, one of the best aids to the clinical study of disease, and it is well worth while to acquire the necessary skill to write reliable and informative histories where such history falls in the routine of a nurse's work.

CHAPTER VII

EXAMINATION OF VOMITUS, SPUTUM, AND EXCRETA

THE VOMITUS

By vomitus we understand the contents of the stomach which have been ejected. All vomited matter should invariably be carefully inspected. The composition of the vomitus itself, its odor and color, are valuable indications of the state of the digestion and the condition of the upper part of the alimentary tract, while the character of the vomiting, the time at which it occurs, whether soon after the meal or toward the end of digestion, and the symptoms which accompany the act, help to determine the cause of the vomiting. In the case of poisoning the vomitus is of important diagnostic value and should always be saved for examination. Vomitus, when required for examination, should be covered to protect it from air and dust, but not otherwise disturbed. It should not be mixed with a disinfectant.

Character of Vomiting.—The simplest form of vomiting is a *regurgitation* or overflow of food from the stomach directly after it has been taken. It is frequently seen in infants that have been too quickly fed or that have taken too much food at one time. In others regurgitation frequently signifies a stricture, either of the esophagus or at the upper opening of the stomach.

An attack of vomiting is usually preceded by headache, nausea, distress, and frequently gastric pain. The act is accompanied by retching and noisy eructation of gas; the attack is followed by a sensation of relief and ease.

In certain conditions large quantities are ejected from the stomach at a time, amounting even to a gallon or more. The condition is known as *profuse vomiting.* Profuse vomiting occurs in conditions associated with *dilatation*

of the stomach, of which one of the most common causes is cancer of the pylorus (the valve at the lower opening of the stomach).

Forcible or *projectile vomiting* occurs without preliminary distress. The contents of the stomach are forcibly ejected to considerable distance. The condition is most generally seen in certain diseases of the brain. It is due to disturbance of the nerve-centers, and not to local irritation. (See also Chap. XX.)

Consistence of the Vomitus.—In the ordinary attack of vomiting the vomitus consists of food which has undergone partial digestion. It has a sour taste and odor. Where vomiting occurs when the stomach is empty of food, the vomitus consists of small quantities of green or yellow-green fluid, of clear appearance, and of very acid taste. This is the so-called bilious vomiting, the ordinary accompaniment of the bilious attack, sea-sickness, and the vomiting following anesthesia.

In abnormal conditions the vomitus may contain abnormal constituents of special significance. The most common are excessive mucus, blood, pus, and fecal matter.

Excessive **mucus** in the vomitus is most commonly a chronic condition, associated with chronic gastric disease; occurring as an acute condition, it is probably due to poisoning by the irritant or corrosive poisons.

Blood in the vomitus may be either *fresh* or *altered*. *Fresh* blood has the appearance of streaks mixed with mucus or other contents of the stomach. It is seen in the vomitus caused by the irritant or corrosive poisons, and may also come from a lesion in the upper part of the alimentary tract. *Altered* blood is blood which has remained long enough in the stomach to be acted upon by the digestive juices. It is brown in color, and in many cases has the appearance of a deposit of *coffee-grounds*. *Coffee-ground vomitus* is common in ulcer of the stomach, cancer of the stomach, and peritonitis.

The vomiting of large quantities of blood (*hematemesis*) is most commonly a symptom of gastric ulcer. The blood may be fresh or altered. It usually occurs shortly after food has been taken.

Stercoraceous or fecal vomitus has the odor and appearance of feces and is unmistakable. It is always a symptom of grave importance. It indicates obstruction at some point in the intestines, in consequence of which the contents of the intestines are regurgitated into the stomach. (See Treatment of Vomiting, p. 699.)

Pus may be present in the vomitus as the result of the rupture of an abscess into the upper part of the alimentary tract, as, for example, into the pharynx as from quinsy, or into the esophagus.

Examination of the Stomach.—In conditions associated with gastric disorders special examination of the stomach may be necessary.

To map out the area occupied by the stomach the patient is given, while the stomach is empty, a Seidlitz powder, or other effervescing preparation; the stomach is dilated by the gas, and, unless the abdominal wall is very thick, the size and position of the organ may in this way be determined.

Tests are also made to determine the condition of the gastric secretions, the *absorptive activity*, and the *motor activity* of the stomach.

Test-meals.—For the first, an examination is made of the gastric contents during digestion; for this purpose the patient is given what is known as a test-meal. The meal is given on an empty stomach, usually after the night's rest; the patient is cautioned to masticate thoroughly and to eat slowly. After a given time the contents of the stomach are siphoned off by the stomach-pump. The test-meals usually employed are the breakfasts of Ewald or of Boas, or the test-meal of Riegel.

Ewald's Breakfast.	Boas' Breakfast.
1 roll. $\frac{1}{2}$ pint of tea without milk or sugar (or $\frac{1}{2}$ pint of water).	6 ounces thin oatmeal gruel.

Remove at the end of an hour.

Riegel's Test-meal.

8 ounces plain meat broth.
7 ounces tender broiled beef-steak.
$1\frac{1}{2}$ ounces mashed potato (or a roll).
Remove three hours after consumption.

Chemical tests are then applied to the contents thus removed, to determine the total acidity of the gastric contents, the presence of the digestive ferments, and of various acids elaborated during digestion.

The normal *acidity* of the gastric juice is due to *free* hydrochloric acid, a natural secretion of the stomach essential to the digestion of nitrogenous foods (Chap. XXI). In health the gastric juice contains about 0.2 per cent. hydrochloric acid. The acidity of the gastric contents is often of diagnostic value. In health the acidity may be persistently increased (*hyperacidity, hyperchlorhydria*) by the overuse of nitrogenous or richly seasoned foods, and in persons of highly nervous temperament; hyperacidity is usually present in cases of gastric ulcer and in a variety of nervous disorders. A decrease of acidity (*subacidity*) is a common accompaniment of prolonged disturbed gastric conditions, such as chronic gastritis from a variety of causes; in cancer of the stomach there is usually either marked subacidity or the acidity is entirely absent (*anacidity*).

The **motor activity** of the stomach is determined by noting the amount of food remaining in the stomach at a given interval after one or other of the test-meals described above. After two hours there should be no remains of either of the breakfasts, and after seven hours but little food from the Riegel test-meal. If any quantity of the food remains, the motor power of the stomach is reduced. In place of the test-meals one pint of cool water may be used. After an hour and a half practically no water should remain in the stomach.

Loss of motor power is usually associated with dilatation of the stomach, due either to muscular weakness of the walls of the stomach or to an obstruction at the pyloric valve, such as cancer.

The **absorptive activity** of the stomach is usually tested by administering to the patient a *capsule* containing 15 grains of potassium iodid, and noting the length of time required before iodin is found in the saliva. To test the saliva a filter-paper is saturated with starch and touched to the saliva. One or two drops of strong nitric acid are

added, when, if iodin is present, the paper will turn a bright blue. If the absorptive activity is normal, the reaction should take place in from ten to fifteen minutes. The test is not considered very reliable.

THE SPUTUM

By sputum we mean the abnormal secretions which collect in the lungs and air-passages as a result of inflammatory conditions, and are expelled by coughing. The condition of the sputum represents the condition of the affected organ, and is consequently of diagnostic importance. Sputum may be present in any condition which alters or overstimulates the secretion in the lungs or air-passages, or where, as from the rupture of a blood-vessel or abscess, extraneous fluid may be present.

Sputum may be thin and watery and easily coughed up, or thick, tenacious, and difficult to get rid of. Easy expectoration is usually considered a favorable sign in disease. In old age and in conditions of extreme prostration sputum is expectorated with great difficulty, so that finally the secretions accumulate in the lungs, practically arresting their function.

Sputum may be *scanty* or *profuse*. Commonly it is scanty at the beginning of diseases of the lungs, and more profuse as the disease progresses. The amount is greatest on first wakening, the secretions having accumulated in the air-passages during sleep.

Sputum is described, according to its composition, as *mucoid, mucopurulent, rusty, prune-juice, watery, bloody, purulent, red-currant jelly, gangrenous or fetid*, and *nummular.*

Mucoid.—The thin expectoration common in early bronchial congestive and other catarrhal conditions of the respiratory tract is known as *mucoid.* As inflammation progresses the mucoid expectoration becomes *mucopurulent.* The sputum is then thick, tenacious, and greenish-yellow. It is *inoffensive*, with a faint, sweetish odor and taste, and frequently very difficult to cough up. In the later stages of lobar pneumonia the mucopurulent sputum has a characteristic **rusty color.** This is due to blood which has

exuded from the inflamed lung tissue and become mixed with the secretion. It is known as *rusty sputum.*

In grave cases of pneumonia the blood is exuded from the inflamed tissue in larger quantities, and mixed with disintegrated organic matter. In consequence of the low vitality of the patient the blood is retained in the air-cells and passages for a greater length of time, and becomes *altered*, giving to the sputum a dark brownish color considered to resemble **prune juice**. This is known as *prune-juice sputum*, and is considered an unfavorable symptom. It is common in the senile forms of pneumonia.

The above forms of sputum are common, and will be met with at all times in nursing diseases of the respiratory organs. The following are more rarely met with:

Watery Sputum.—The expectoration of quantities of frothy watery fluid is a symptom of *edema of the lungs*, in which condition the air-cells become filled with an effusion of serous fluid.

Bloody Sputum.—The expectoration of fresh blood from the lungs (hemoptysis) is always a grave symptom. It is bright red, mixed with air-bubbles, which give it a frothy appearance (except when in very large quantities), and is *coughed* up; these points should be remembered in distinguishing between hemorrhage from the lungs and from the stomach (Chap. XVII). The quantity of blood expectorated at a time is not usually considerable unless in case of the rupture of a large vessel from injury or disease. The most common cause of hemorrhage from the lungs is pulmonary tuberculosis.

Red-currant Jelly Sputum.—This is considered diagnostic of cancer of the lung. The disintegrated tissue mixed with the natural secretion of the lungs is considered to have the appearance of red-currant jelly.

Purulent sputum, that is to say, sputum composed almost entirely of pus, denotes that an abscess has ruptured in the air-vesicles. The abscess may be in the lung tissue itself, as in the suppurative stages of phthisis, or from a neighboring structure, most commonly from a pleural abscess. Frequently almost the entire contents of the abscess are coughed up at one time. The sputum pre-

sents the characteristic appearance of pus. It is offensive and frequently streaked with bright blood.

Gangrenous Sputum.—Gangrenous sputum is recognized by its overpowering fetid odor. It indicates that some portion of the lung tissue has become gangrenous. This occurs most commonly in advanced phthisis or from ulceration of the walls of the bronchi in chronic dilatation of the bronchi. The condition may also result from accidental injury, such as a gun-shot wound.

Sputum in Tuberculosis.—The sputum in pulmonary tuberculosis has a characteristic round, flat appearance, to which the name *nummular* has been given, from its supposed resemblance to a small coin. It is expectorated in small, separate, semisolid, round, flat masses, considerably denser than the usual forms of sputum. Placed in water, these small masses sink to the bottom, whereas ordinary sputum, freely incorporated with air-bubbles, floats on the top.

False Coloring of Sputum.—The sputum of miners and chimney-sweeps will generally be of an abnormally dark color or speckled with small black particles. This is due to atoms of coal-dust, with which the lung tissue has, in course of time, become impregnated. The sputum of inveterate tobacco smokers may also have a characteristic discoloration.

Sputum as a Source of Infection.—In all infectious diseases of the lungs or air-passages the bacteria of the disease will probably be found in the sputum. This is in a special degree the case in pulmonary tuberculosis, where the presence of the organisms in the sputum is considered conclusive proof of the disease. The sputum in such infections as diphtheria, scarlet fever, etc., contains discharges from the throat, in which the bacteria of the disease are present in large quantities. In the sputum of diphtheria shreds of false membrane are frequently present. All such sputum must be regarded as *infectious*, and means taken that it should not be allowed to become a source of danger or channel of infection to others.

Sputum-cups.—Sputum not required for examination should be received in vessels containing a disinfectant,

and closely covered when not in use. A great source of infection from sputum-cups is in small deposits allowed to accumulate on the brims; these are left exposed to flies, whom we now regard as important transmitters of disease, or, allowed to dry, become detached, and float as imperceptible particles in the air (p. 388). Sputum-cups should be cleaned at least twice a day and scrubbed with hot suds; once every twenty-four hours they should be sterilized by boiling for ten minutes. In cleaning the cups care must be taken not to contaminate the fingers, and the habit should be insisted upon of thoroughly cleansing the hands immediately after the operation.

Where sputum-cups are not used, the sputum should be received in small squares of soft paper or rag and burned. (See also p. 413.)

Examination of Sputum.—When sputum is required for examination, it should be coughed directly into a wide-mouthed glass bottle, previously sterilized, and corked with sterile absorbent cotton. The outside of the bottles should be carefully wiped with a cloth saturated with a solution of bichlorid of mercury, 1 : 1000, or other strong disinfectant. A common cause of infection in laboratories is traced to the handling of such bottles, on the outside of which small quantities of sputum have been deposited and left to dry.

The specimen of sputum from a child is often difficult to obtain, children having a tendency to swallow their sputum. A practical method is as follows: Roll a piece of sterile gauze round your finger; during the attack of coughing pass the finger quickly to the back of the throat, fold the gauze round the sputum which adheres, and place directly in a sterile bottle.

The **microscopic examination** of sputum is for the purpose of observing certain crystals which have a diagnostic value, and for the detection of any bacteria present, the most important of which is the rod-shaped bacillus of tuberculosis. In many hospitals nurses are taught a simple method of preparing such specimens and to examine them under the microscope (p. 366).

THE EXCRETA

THE FECES

The condition of the feces, as passed in the evacuations of the bowel, is important both in health and in disease, and requires intelligent observation.

Normal Stool.—The stools are formed of the débris of food-stuffs, mixed with the digestive juices and excretions of the alimentary canal, including the bile, which gives the feces a golden-brown color. In a healthy condition the stool should be formed or semiformed, from light to dark brown in color, of one consistence throughout, and with a characteristic *fecal* odor.

Stool in Infancy.—The first evacuations of the new-born infant are liquid, sticky, dark brown in color, and odorless. They consist of *meconium*, the contents of the bowel at birth, and contain no food-substances.

The meconium is replaced by the golden-yellow stools of the suckling, which have about the color and consistence of freshly made mustard paste, and should be smooth, almost odorless, and free from undigested curds of milk or mucus.

Stool of Milk Diet.—In young children and in patients fed entirely on a milk diet the stools are yellow in color and have less odor than when a richer diet is taken, less completely digested, and more likely to produce fermentation.

Consistence of Stools in Constipation.—When the feces remain too long in the bowel, they become dry, hard, and darker in color, and are passed with pain and difficulty; frequently they may be streaked with blood from slight bleeding at the anus.

In Diarrhea.—In diarrhea the consistence of the stools is changed and their frequency increased; they become loose, liquid, or watery, and should be examined for undigested food, mucus, and blood.

Undigested Stools.—In infants, young children, and those fed on milk it is common to find curds of milk in the stools. In a breast-fed baby these have the appearance of small light spots of more solid consistence than the stool; in a bottle-fed baby the curd is larger and more

easily recognized. Where the stool is otherwise healthy, curds passed in the stools usually indicate either that too much milk is being taken at one time, that the proportion of protein is too large, or that there is a deficiency of the gastric juice, conditions easily modified. Where, besides containing curds, the stool is greenish, slimy, and offensive, the digestion is seriously disturbed. Shreds of undigested food are also not serious if the stool is otherwise healthy, but should be noted and the diet corrected by their indication. Improper mastication and bolting of food are common causes of undigested stools.

Watery Stools.—Stools of very thin consistence, known as watery stools, are noticed in all forms of cholera, as cholera morbus, cholera infantum, etc., and are a severe drain on the system. In these conditions the movements are accompanied by acute cramping pains. Watery stools may also be the result of the action of saline purgatives, or of such drastic purgatives as croton oil (1 to 2 minims) or elaterium ($\frac{1}{10}$ to $\frac{1}{6}$ grain), and are a characteristic symptom in corrosive or irritant poisoning.

Mucus.—The presence of mucus in the stool gives it a slimy appearance, and indicates intestinal irritation; it is a symptom in enteritis, colitis, and dysentery, and may follow overpurging from any cause. Where the small intestine is the seat of irritation, the mucus is mixed with the stool substance; in inflammation of the colon it lies on the surface of the stool. After free purging the evacuation may consist entirely of mucus. In an inflammatory condition known as mucous colitis mucus is passed in long strands of pseudomembrane, forming frequently regular casts of the bowel.

Blood.—Blood in the stools may result from overpurging, from acute catarrhal or inflammatory conditions of the intestines, or from lesions giving rise to hemorrhages in some part of the alimentary canal. The blood may be either *fresh* or *altered*, intimately mixed with the stool, or lying on the surface; it may be passed in any quantity, from a few streaks to a copious outpouring immediately fatal to life.

Mixed with mucus and passed in small quantities with

the stool, it is a common accompaniment of intestinal inflammation; passed after the stool and free from mucus, it generally signifies bleeding from the anus, of which the most common cause is the presence of hemorrhoids. Bloody stools occur in cancer of the rectum or other portions of the alimentary canal, in scurvy, and in purpura, in which latter condition the quantity of blood passed at a time is frequently great.

Hemorrhage From the Bowels.—Hemorrhage or profuse bleeding from the bowels is commonly the result of an ulcerated condition of the stomach or intestines, and may be looked for in typhoid fever and in gastric and duodenal ulcers. If a fresh hemorrhage, occurring low down in the intestine, the blood is bright red and clots quickly, often before being passed; if it has remained some time in the intestine, it has become *altered* by the digestive juices and intimately mixed with the stools, to which it imparts a characteristic black, *tarry* appearance.

Hemorrhage from the bowels is always a condition of the gravest importance (p. 600). After operations on any part of the alimentary canal the appearance of blood in the stool should be watched for. In examining stools, especially for blood, the possibility of the presence of vaginal discharges should be borne in mind.

Pus.—Pus in the stools is not easy to detect in small quantities, and microscopic examination is resorted to; in a larger amount it may be mistaken for a thick, liquid stool, especially if colored by the feces and having a fecal odor. In small quantities and mixed with the stool pus is a symptom of severe intestinal inflammation; passed in a larger quantity, with or without a stool, usually it is the result of the rupture of an abscess into the intestinal tract.

Fat.—Fat is sometimes detected in the stools in chronic diseases of the pancreas or where fat is taken too freely in the diet. The stools of patients fed chiefly on cream, as in some infant feeding and in the high caloric liquid diet ordered by some physicians in typhoid cases, should be examined for fat-particles, loosely and wrongly called fat-curds.

Odor of Stools.—Stools are made offensive by the action

of bacteria, by decomposed food-particles, or by being mixed with offensive discharges, as from cancer or an abscess opening into some part of the intestines. Offensive stools are characteristic of enteritis, of typhoid fever, and of the diarrhea of tuberculosis and other septic conditions.

Color of Stools.—The *green* color so frequently seen in unhealthy stools is usually attributed to the action of intestinal bacteria, or may be caused by an excessive amount of bile (Stevens). It is common in many forms of intestinal irritation, especially in the enteritis of children.

Persistent *greenish-yellow*, liquid stools, of the consistence and appearance of pea-soup, with an offensive odor, are a characteristic symptom of typhoid.

Stools may be turned *black* by the presence of altered blood, and are then known as *tarry* stools, or by certain drugs, iron, bismuth, and charcoal. Food which contains iron, such as spinach, will also cause black stools. Black stools are described as *melanotic*.

Methylene-blue will impart a *blue* color to the stools, and logwood will color them bright *red*. The latter is important to bear in mind, as logwood is an astringent not infrequently used in the diarrheas of childhood, and the red color, resembling blood, gives the stool an alarming appearance.

The possibility of coloring the stools by drugs taken by the mouth is made use of in determining the time, in different cases, required for food-stuffs to pass through the intestines; in other words, the motor activity of this part of the digestive tract. A coloring substance, such as one of the anilin dyes, which has no action on the intestines, their secretions, or their contents, is given, and the length of time between its administration and the staining of the stools the characteristic color is noted.

Absence of Color.—*Absence* of color denotes absence or diminution in the quantity of bile, and the result is the clay-like stool found in jaundice, associated with inflammation or obstruction of the bile-duct. A chalky appearance somewhat resembling the clay-colored stool may be given to the light stools of young children by the administration of chalk.

Poisons.—Very many of the poisons are eliminated by the stools, and their diagnostic value in such cases should be remembered. In poisoning from phosphorus the stools have a phosphorescent or luminous appearance when placed in the dark. Poisoning by the irritants or corrosives will be accompanied by mucous, bloody, or watery stools, according to the severity of the injury to the alimentary tract.

Foreign Bodies.—Foreign bodies, such as coins, buttons, small playthings, and the stones of fruits, are not infrequently found in the bowel movements of children, and are easily recognized. Less easy of detection are small *gall-stones*, which occasionally find their way into the intestines through the bile-ducts and are passed in the stools. Where their presence is looked for, the stool may be rubbed through a seive, or it may be turned on to a double piece of cheese-cloth, about a yard long, the ends of which are then forcibly twisted in opposite directions, thus wringing the stool through the cheese-cloth. This should be done under a running tap of cold water. When the stool has been squeezed and washed away, the cheese-cloth is opened and the gall-stones may be found. They are irregular bodies, of extremely light weight, and may be brown or pearly white; they vary greatly in size, but those passed in the stools are generally very small, and might easily be mistaken for fruit-seeds.

Parasites.—Round worms and segments of the various tape-worms which may infest the intestine are frequently met with in the stools. The common earth-worm is easily recognized. Seat-worms, often passed in great numbers, appear like little threads, and usually are moving actively; the largest is about half an inch long. Segments of the tape-worm appear as nearly square white bodies, attached together in chain-like formation. Where the whole worm is recovered, it may be several yards in length. Where treatment is given to expel a tape-worm, it is desirable to preserve it intact, and in particular to ascertain if the small head, with its hooklets, has come away. The head is extremely minute, the size of a pin's head, with a neck like a delicate thread, and is, therefore, easy to lose.

It is the most important part of the worm, as if left in the intestine the body will grow again.

Bacteria.—In many infectious diseases the stools contain the bacteria of the disease in great numbers. This is especially the case in typhoid fever, cholera, and all the "water-borne" (p. 388) infections. Pupils should be carefully taught from the beginning practical precautions in dealing with these stools (p. 409). The smallest stain from a stool on linen or vessel should be regarded as an active colony of bacteria and a prolific channel of infection.

In typhoid fever it should be borne in mind that bacteria may persist in the stools long after recovery, making the patient a menace to the health of those with whom he lives.

Preparation of Stool for Examination.—Where a stool is to be preserved for examination, it is obviously necessary that the vessel should be absolutely clean and free from such foreign bodies as fluff, dust, and hairs. A specimen glass or a glass preserving-jar is used to put up the specimen, and should be sterilized either by boiling or in the autoclave before use. No disinfectant should be mixed with a stool that is required for examination. Usually only a small portion of the stool is necessary for examination, but if there is any abnormal appearance, such as a quantity of pus, etc., the whole should be preserved as far as possible undisturbed. Specimens should be closely covered and accurately labeled. Usually the hour of passing the stool is noted, as it is often important to make the examination as early as possible.

In disorders of the digestive organs, in cases of malnutrition, and in other conditions the stools are often required to be weighed. This is usually done in the vessel or napkin in which the stool is passed, and the weight of the vessel or napkin deducted from the amount.

THE URINE

Urine is a clear, amber-colored fluid secreted by the kidneys, stored in the bladder, and voided under normal conditions, voluntarily and without pain.

Composition.—Urine is composed of about 960 parts of water to 40 of solid matter. This proportion is modified in health by transitory conditions, as, for example, the ingestion of foods or fluids, after severe sweating, as the result of exercise, etc.; it is also altered in those diseases associated with disturbances of nutrition, such as fevers.

Solids.—The solid portion of urine is composed of urea, uric acid, inorganic salts, a small amount of organic matter, aromatic substances, and pigment.

Urea.—Urea is the chief solid constituent of the urine, and the elimination of urea we may take as the most important function of the kidneys. Urea is produced in the body as the result of the combustion or oxidation of protein or nitrogenous food (Chap. XXI). If allowed to accumulate in the blood, symptoms of acute poisoning quickly manifest themselves, followed by death if the condition is not relieved. By far the larger portion of the elimination of urea is performed by the kidneys, the small amount lost in normal conditions through the activity of the sweat-glands being insufficient to avert poisoning. In a normal condition about one ounce of urea is excreted in the urine in twenty-four hours. The average proportion of urea in a twenty-four-hour specimen of healthy urine is about 2 per cent., or one-half the entire solid constituents of urine. The proportion of urea in the urine is temporarily increased by the following conditions: (1) A meal of protein food; (2) after exercise; (3) in the early stages of acute fevers. It is permanently present in excess in the urine of diabetic patients. The proportion is *decreased* after: (1) The ingestion of large quantities of water; (2) in conditions of lowered vitality; and (3) in some diseases of the liver and kidney.

Uric Acid.—Uric acid is also considered to be a result of the nitrogenous waste of the body. It is found in the urine usually in the form of uric acid salts or *urates*. Urates are formed by the combination of uric acid with one or other of the solid constituents of urine, lime, soda, magnesia, etc. The presence of urates in excess gives to the urine a turbid appearance on cooling, and an increase of acidity. A persistent excess of uric acid is apt to lead to

the formation of deposits which develop into urinary calculi, or "*stones*."

The proportion of uric acid is temporarily increased by nitrogenous food and by conditions that tend to concentrate urine, such as severe sweating, etc.; it is temporarily diminished after drinking quantities of water. Many forms of disease are accompanied by increase in the quantity of urates, especially those in which the processes of nutrition are impaired, such as fevers. Another product of nitrogenous waste, known as *creatinin*, is also normally present in urine. It is of minor importance.

Salts.—In chemistry the product of the union of an acid with a base or element is called a *salt*. The bases of a variety of salts are found in normal urine. The principal are *urea*, *magnesia*, *lithia*, *potash*, and *soda*, *phosphoric acid*, *sulphuric acid*, and *chlorin*, the combination of which form such salts as *phosphate of magnesia*, *sodium chlorid*, etc.

Pigments.—Pigments give the urine its characteristic amber color. The most important is *urorobin*. They are present in a larger proportion in concentrated urine, which has, consequently, a higher color than that passed in larger quantities. When passed in abnormally large quantities, urine is nearly colorless.

Aromatic Substances.—A few aromatic substances are present in urine, of which the most important is *hippuric* acid.

Organic Matter.—The principal organic substances found in urine are mucus, epithelium, and fat, in very minute quantities.

Specific Gravity.—The *specific gravity* or *density* of either a fluid or a solid is ascertained by referring to water as the unit of comparison. A body twice the weight of water, bulk for bulk, is said to have a specific gravity of two; ten times, the specific gravity of ten, and so forth. The solid substances in urine give it greater weight or "*higher specific gravity*" than water. Taking the specific gravity of water at 1000, normal urine has a specific gravity of from 1015 to 1025—*i. e.*, 1.5 to 2.5 more than the weight of water. The specific gravity is higher in

concentrated urines rich in urea, and abnormally high, 1035 and over, in the disease known as diabetes mellitus, where the urine although passed in enormous quantities, contains sugar, and is usually rich in urea. It is lower in pale, copious urines deficient in urea, and usually in those conditions where the urine contains albumin.

Reaction.—Normal urine has a slightly acid reaction, which varies somewhat at the different times of the day. After a meal, especially of vegetables, it is neutral or may be alkaline. The acidity is greater in conditions where the uric acid is increased, especially in diseases which are associated with excess of uric acid, such as gout and rheumatism.

Urine becomes alkaline upon decomposition, either within the bladder, as in the urine of cystitis (inflammation of the bladder), or after it has been passed. The latter is the result of bacterial activity, and may be averted for a length of time by keeping the specimens in a clean, sterile vessel closely covered from the air. Urine may also be rendered alkaline by the inhibition of alkaline waters, such as lithia water, etc. Pus also, if present in the urine, gives it an alkaline reaction.

Abnormal Substances Found in Urine.—The constituency of urine is affected in many diseases and disordered conditions of health. In some cases one or other of the normal constituents may be either present in excess or reduced in proportion; in other cases extraneous substances may be found. The principal extraneous substances that may be looked for are albumin, blood, pus, bile, and sugar, and more rarely chyle. In many of the infectious diseases the bacteria producing the disease are observed in the urine. In cases of poisoning by drugs, traces of the poison may often be found in the urine; the urine, therefore, of suspected cases should invariably be saved for examination.

Color.—The color of urine is changed by deposits and by several drugs. Thus an excess of urates will give urine an *orange-red color*.

Blood imparts a *smoky* appearance or a *blood-red* color.

Bile gives the color of *porter*.

A quantity of mucus or the presence of pus or chyle gives urine a *milky* appearance.

A *pink* sediment frequently seen in concentrated urine is due to the action of urates on the pigments; it disappears when the urates are dissolved.

Drugs which may give a characteristic color to urine are as follows:

Iodoform, carbolic acid, and its derivatives	*Dark olive-green.*
Rhubarb and senna	*Bright orange color.*
Logwood	*Bright red (may be mistaken for blood).*
Santonin	*Saffron yellow.*
Methylene-blue	*A blue-green color (often used for diagnostic purposes).*

Clearness.—The above conditions also affect the clearness of urine. Thus urine containing blood, bile, mucus, or pus is *opaque* in proportion to the quantity of the deposit. Urine containing an excess of urates is thick and turbid after it cools, though on passing it is quite clear. A light, flocculent cloud floating in clear urine is usually due to a small quantity of mucus and has no significance.

Odor.—The odor of urine is like nothing else, and is described as *urinous.* On decomposition it becomes ammoniacal. Freshly voided urine with an ammoniacal odor points to cystitis. The odor is affected by drugs to a slight extent; thus turpentine is said to give urine an odor of violets; sandalwood, tolu, cubebs, and copaiba each impart a characteristic odor. Asparagus, even taken in small quantities, gives urine a disagreeable odor.

Quantity.—The normal quantity of urine voided in twenty-four hours is from 2 to 3 pints. The quantity may be temporarily increased by excitement, exertion, the application of cold to the skin, or by drinking a quantity of fluid, and by the action of certain drugs known as *diuretics;* it is usually increased in hysteria, during a crisis, and in most cases of chronic Bright's disease; in diabetes the quantity is enormously increased and may average several quarts a day. A temporary marked increase in the quantity of urine, as, for example, during a crisis, is called a *diuresis;* a more permanent condition

of increased quantity is known as *polyuria*. In some acute diseases a mild condition of polyuria is considered a favorable symptom. This is especially the case in typhoid fever.

A decrease in the quantity of urine is noticed in all fevers, in acute diseases of the kidneys, and in conditions associated with dropsy, in uremia and after severe hemorrhages, vomiting, or diarrhea; the quantity may be decreased by a dry diet and by the action of drugs that diminish secretions, such as opium and ergot. When the quantity passed is very small, the condition is known as *oliguria*; when no urine is secreted, it is termed *anuria*, Anuria, if persistent, is quickly fatal to life, owing to the accumulation of urea in the system.

Examination of the Urine

The condition of urine is such an important aid to diagnosis that its examination is in all diseases a matter of routine work. A specimen for examination should be taken either from the collected quantity passed in twenty-four hours or from the urine voided first in the morning, before food or drink is taken. Urine passed after the ingestion of food is rich in solids, especially in urea, while the urine after drinking contains a larger proportion of water; the urine first voided after the night's fast is, therefore, the purest specimen. Where urine is collected for twenty-four hours, the reckoning should begin, to insure accuracy, immediately *after* the first voiding after the night's sleep one morning (the specimen not to be included), and end with and include the first voiding on the following morning, as nearly as possible at the same hour. When vaginal discharges are present, the specimen is procured by catheter.

The vessel in which the specimen is put up must be sterilized by boiling and perfectly clean, free from dust, fluff, or hair, etc., which interfere with the examination of the specimen and may set up decomposition in the urine.

Each specimen should be accurately labeled with the name, date, hour of passing, quantity from which the

specimen is taken, and a note as to whether it is the specimen of a single voiding or of a twenty-four-hour collection of urine. Urine is examined both by microscope and by chemical tests.

Microscopic Examination.—The microscope is used to examine organic matter, the crystals of various salts, and to detect the presence of bacteria.

A specimen for microscopic examination is placed in a conic-shaped glass, and any deposit present allowed to settle to the bottom. The liquid part may be poured off, and the deposit examined separately. The process in laboratory work is hastened by the use of an apparatus called a *centrifuge* (Fig. 61), on the tubes being rapidly rotated the solid and fluid particles are separated; it acts on much the same principle as a dairy cream separator.

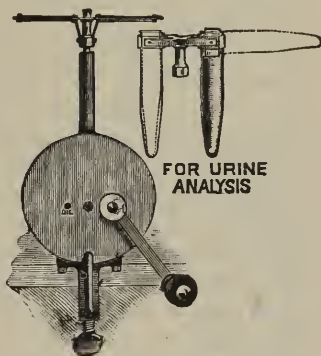


Fig. 61.—Centrifugal machine.

The principal abnormal organic constituents of urine are blood, pus, and what are known as casts.

Casts.—Casts are the results of an abnormal exudate, generally of serum, from the blood into the uriniferous tubes of the kidney; the exudate becomes coagulated, and is passed out in the urine as microscopic molds or *casts* of the tubes, of varying size. Their presence is a sign of an inflamed or diseased condition of the kidney.

Simple casts, formed of a clear, pellucid exudate, without débris from other organic matter, are known as *hyaline* casts; where they are darker in color and more solid they are described as *waxy* casts. Hyaline casts are found in all disorders of the kidneys, and in various other conditions, and may also, to some extent, be present in health. Waxy casts are usually considered significant of an advanced chronic disease of the kidneys known as *parenchymatous nephritis.*

The casts may contain blood-cells, pus-cells, epithelial cells, or bacteria, according to the condition of the diseased kidney, and are then described as *blood, pus, epithelial,* or *bacterial casts. Epithelial casts* occur in the early stages of acute inflammation of the kidneys; in the later stages the epithelial lining of the tube becomes broken down into débris, and casts showing this débris are known as *granular casts.* In chronic nephritis epithelial degeneration is frequently shown by the presence of oil-drops in the casts, which are then described as *fatty* or *oily casts.*

Crystals.—The crystals of uric acid and the various salts in the urine may be studied under the microscope, the presence of the different varieties being, in many instances, of diagnostic value. For example, certain crystals formed by the union of the phosphates with ammoniomagnesium and known as *triple phosphates,* occur only in decomposed urine; if, therefore, they are found in urine when freshly voided, their presence indicates that the urine is decomposed while in the bladder and points to cystitis.

Blood and Pus.—The presence of blood or pus in the urine is determined with the microscope by detecting the red and white corpuscles of the blood and the leukocytes which form the pus-cells.

The microscopic examination of urine can be carried out only by an expert in the use of the microscope. The above brief description is, however, necessary for an intelligent understanding of the results attained by the examination.

Chemical Examination.—For a chemical examination of urine a tray should be arranged containing the following:

Urinometer and glass.

Red and blue litmus paper.

Filter-paper.

Pipet.

Alcohol lamp.

Conic glass.

Test-tubes.

Test solutions—of which the principal are *nitric acid, acetic acid, sulphate of copper, liquor potassæ, tincture of guaiacum,* and *ozonic ether,* about half an ounce of each in small bottles.

The chemical examination will determine the presence and nature of abnormal substances in solution. The finding of one substance does not preclude the presence of another. The substances sought for are an excess of urates or phosphates, albumin, blood, pus, excess of mucus, chyle, and sugar.

The examination should proceed methodically, step by step, always in the same order, so that no point is overlooked.

1. Observe the specimen carefully, its color, its clearness, and note the presence and character of any deposit; urine that is not clear is described as *cloudy*.
2. Take the specific gravity.
3. Test the reaction.
4. Boil the specimen.
5. Apply the reactionary agent or test.

Specific Gravity.—To take the specific gravity a urinometer and a glass vessel of sufficient size for the urinometer to float in it are required. A cylindric glass about $1\frac{1}{2}$ inches in diameter, with a capacity of 5 ounces, is generally used. The urinometer consists of a dial marked off in degrees, much like the dial of a thermometer, attached to a small air-chamber, the latter weighted by a bulb of mercury; placed in a fluid, the instrument floats with the dial upright.

The glass filled with the urine to be examined, the urinometer is floated in the urine, taking care that it floats freely and does not touch the bottom or sides of the glass. The number on the dial immediately on the level of the urine indicates the specific gravity of urine as compared to water, the weight of which, as said above, is taken as the unit of comparison.

Reaction.—Red or blue litmus paper or yellow turmeric paper may be used to test the reaction of the urine. The paper is touched to the urine for examination, and any change compared with the unaltered paper.

Acid urine turns blue litmus paper red and intensifies the color of the red litmus paper.

Alkaline urine turns red litmus paper blue and intensifies the color of the blue litmus paper.

Neutral urine does not alter either red or blue litmus paper.

Acid urine turns yellow turmeric paper brown.

Boiling.—In boiling urine the object is to dissolve those substances which are soluble by heat, and to cause those to appear which are visible only when coagulated, as by heat. Boiling does not alter the appearance of normal urine.

Two-thirds of the test-tube should be filled, and only the upper half heated, in order that the heated and unheated portions may be compared and delicate differences observed. The tube should be held by the lower end slantwise above an alcohol flame, with the open end turned away from the operator to avoid accidents.

A substance which appears in the urine on testing is called a precipitate, one visible before testing, a deposit. A precipitate is said to be *formed* or *thrown down.*

Urine containing *excess of urates* is clear when voided, and on cooling becomes thick, with a dense orange cloud. It is highly colored and strongly acid. Usually it has a deposit of pink pigment which stains the sides of the vessel. On heating the urine the cloudiness disappears, leaving the specimen clear, urates being *soluble by heat.*

Urates (the salts of uric acid) are present, it will be remembered, in normal urine in small quantities. They are increased in quantity in all conditions in which urine is concentrated or scanty; such, for example, as in feverish conditions, after free perspiration, and in conditions associated with uric acid, such as gout.

Excess of Phosphates.—Phosphates may be present in either clear or cloudy urine, and are invisible before heating. The urine is either neutral or alkaline, as phosphates are soluble by acid. On heating the urine it is observed to grow denser, and a little cloud appears in the heated portion. A few drops of acetic acid or one or two drops of nitric acid are gently added, and the specimen lightly shaken. If the cloud is composed of phosphates, the acid will dissolve it and the urine become clear again. Like urates, phosphates are found in normal urine, and their presence in excess does not indicate disease of the urinary

tract. Patients suffering from chronic debility, diseases such as rickets, dyspepsia, etc., frequently have an excess of phosphates in the urine.

Albumin.—Albumin may be found in urine that is either clear or cloudy, acid or alkaline, or containing any other abnormal substances (*albuminuria*). As a rule, the specific gravity is very low—below 1008. Albumin is always present in urine containing either blood or pus.

If the suspected urine is cloudy, it should be passed through filter-paper before testing.

If the reaction is alkaline, the specimen should be made slightly acid by the addition of a few drops of acetic acid before testing.

On heating, a cloud similar to that of the phosphates is seen, caused by the coagulation of the albumin. On adding acetic acid or nitric acid, however, the cloud, instead of clearing, becomes denser, and a precipitate is formed by the coagulation of the albumin, which will remain on cooling. Where urates and albumin exist in the same specimen, two-thirds of the test-tube may be filled with the urine; the middle third of the column may be warmed until the urates are dissolved, and the upper third only brought to boiling-point. There will then be seen the lower third of urine turbid from the presence of urates, the middle third of clear urine, and the upper third cloudy with a precipitate of albumin.

The presence of albumin may also be detected by the nitric acid test, also known as *Heller's* test. A small quantity of nitric acid is taken in a test-tube, and on it is floated a column of urine by gently sliding the urine down the side of the test-tube. Where the urine rests on the nitric acid, a white ring will form if albumin is present. Urine containing an excess of urea and no albumin will also show a ring with this test. The specific gravity of the urine will, however, be high, 1025 to 1030, instead of low, as in albuminous urine; the ring does not form exactly over the urine, is not pure white, is less regular in shape, and may be dispersed by boiling.

An estimate of the amount of albumin present may be made by using *Esbach's* albuminometer. This is a test-tube

with the lower part graduated into percentages. The urine is poured in up to a line marked U. The reactionary agent (Esbach's solution of picric and citric acids) is added to a line marked R. The tube is corked with a rubber stopper, and the specimen left for twenty-four hours, at the end of which time the albumin may be seen precipitated at the bottom of the tube, and the percentage read off at the graduated marks. Albumin in the urine is always a serious condition, and usually points to inflammation or disease of the kidneys unless accounted for by blood or pus in the urine, which may be present from various causes not necessarily associated with the kidneys. Albuminuria is found in all forms of kidney disease with the exception of chronic interstitial nephritis, where it is frequently entirely absent. It is a common complication of the acute fevers, especially scarlet fever and diphtheria, and is frequently found associated with heart disease and pneumonia, due, it is considered, to alteration in the blood-pressure. Pressure from tumors or inflammatory processes from neighboring structures may also cause albuminuria, or the condition may arise from deterioration in the quality of the blood, as in the serious anemias.

Fig. 62.—Esbach's albuminometer, improved form.

Poisoning by the irritant poisons, which have an irritating effect upon the kidneys, is also a cause of albuminuria.

Blood.—Blood in the urine (*hematuria*) may come from the kidneys or from any part of the urinary tract. It may be present in any quantity from an amount invisible to the naked eye to a quantity sufficient to give the urine the appearance of bright-red blood; in this latter condition the amount of urine excreted is small.

When from the kidney, it is intimately mixed with the urine, and in small quantities gives the urine a *smoky*

appearance. On standing, a deposit somewhat like beef-tea may be formed. The presence of blood is best determined by the appearance of the urine and by microscopic examination. A chemical test, however, may be made in the following manner:

To a dram of unboiled urine in a test-tube add one or two drops of tincture of guaiacum without shaking; float on the top an excess of ozonic ether; if blood is present, a bright, sapphire-blue ring should appear at the juncture of the urine and the ozonic ether.

Hematuria may be present in acute inflammations or diseases of the kidney, bladder, or urethra. It may be caused by injuries to any part of the genito-urinary tract, as from the presence of calculi or from difficult catheterization. It may result from operations on the genito-urinary tract, or from injuries to neighboring structures, as, for example, a fracture of the pelvis, in which accident the bladder is frequently indirectly injured. Bleeding from the urethra occurs at the beginning of micturition; when from the bladder, at the end. The rest of the urine in either case may be clear. Blood in the urine is always a symptom of importance.

Pus.—Either pus or excessive mucus gives to the urine an opaque, milky, greenish-yellow appearance and an alkaline reaction. Unlike urine turbid from the presence of urates, this specimen is cloudy when first voided. Like blood, the presence of pus is determined best by the microscope and the appearance of the urine.

To make a chemical test the specimen should stand until the deposit settles; the more fluid part may then be poured off, the deposit collected by a pipet and placed in a test-tube. To this is added an equal quantity of liquor potassæ. If the deposit is mucus, it will break up into flocculent particles; if it is pus, it will form a lumpy, gelatinous mass.

Pus in the urine (*pyuria*) arises from a suppurative condition of some part of the genito-urinary tract, or from abscesses from adjacent structures opening into the tract. When from the kidneys, the pus is intimately mixed with the urine.

Mucus.—Mucus is present in large quantities in catarrhal conditions of the bladder.

Chyle.—Chyle in the urine (*chyluria*) is rarely met with, except in patients suffering from the filaria sanguinis hominis, a small, thread-like worm which infects the lymphatics, causing occlusion of the lymphatic ducts. The condition is rarely seen except in tropical climates. The chyle, which should be carried off by the thoracic duct, is then frequently found in the urine. The urine has a milky appearance, due to the finely emulsified fat; frequently it may have a pinkish color, from the presence of blood. That the milkiness is due to the fat may be proved by adding ether to a small quantity of the urine in a test-tube. The ether will dissolve the fat, and the milkiness disappears.

Sugar.—The sugar present in urine (*glycosuria*) in disease is the kind known as grape-sugar, or dextrose (one of the glycogens), and is a normal constituent of the blood. The urine is pale, of high specific gravity, 1030 to 1050, and passed in enormous quantities. Grape-sugar has the property of turning blue oxid of copper into orange suboxid. Copper, then, is used to detect its presence. It may be employed in different ways.

Trommer's Test.—To a small quantity of urine in a test-tube add half the amount of liquor potassæ, then slowly a few drops of sulphate of copper, until the mixture is blue; heat over an alcohol lamp. If sugar is present, an orange-red precipitate will be formed.

Fehling's test is a modification of the above. Take equal parts of liquor potassæ and solution of sulphate of copper and heat in a test-tube. In a second test-tube take a corresponding volume of urine and heat it, then add the urine to the solution by sliding it gently down the sides of the test-tube. If sugar is present, an orange-red color will appear.

Benedict's Test.—In the above tests the reagent should be fresh. For this reason the *Benedict* test, recently introduced, is preferred, especially in private practice. The Benedict solution can be kept indefinitely and its use is easily taught to patients, an important point, as, for ex-

ample, in the treatment of diabetes, patients can be shown how to test the specimen themselves and can regulate their diet accordingly.

The formula is as follows:

1. Copper sulphate..............	17.3 gm. or c.c.
2. Sodium or potassium citrate....	173.0 c.c.
3. Sodium carbonate (crystallized).	200.0 (or *dry* 100 c.c.).
4. Distilled water to make........	1000.0 c.c.

Dissolve the citrate and carbonate together (with the aid of heat) in about 700 c.c. of distilled water; filter into a large beaker; dissolve the copper sulphate in about 100 c.c. of water; mix the two solutions with constant stirring; cool and dilute to 1 liter with distilled water.

To test the urine for sugar, place about 5 c.c. in a test-tube, and add 8 to 10 (not more) drops of urine; boil for one to two minutes vigorously over an alcohol lamp; allow to cool spontaneously; if sugar is present, the solution is filled with a precipitate which may be red, yellow, or greenish in color. If the quantity of sugar is low (under 0.3 per cent.), the precipitate forms only on cooling; if no sugar is present, the solution remains clear, or may show a slight turbidity, bluish in tint, that is caused by precipitated urates.

Böttger's Test.—A different test for sugar may be made by adding to the urine an equal quantity of liquor potassæ with a few grains of subnitrate of bismuth, and boiling. If sugar is present, the mixture turns black. To use this test, the urine must be free from albumin. Albumin contains sulphur, which, if heated in the same way with bismuth, will form the black sulphurate of bismuth.

Quantitative Test for Sugar.—The proportion of sugar may be approximately estimated by the fermentation test. Take the specific gravity, and then place the urine in a corked bottle with a small piece of German yeast, leaving a hole in the cork. Keep the specimen in a warm place or even temperature for twenty-four hours, and then test it for sugar. If all trace of sugar has disappeared, again take the specific gravity. Subtract the present specific gravity from that before fermentation took place, and the difference in the result represents approximately

the number of grains of sugar in each ounce of urine. This test must be made from the collected amount passed in the twenty-four hours.

Sugar is persistently present in the urine in patients suffering from diabetes mellitus. It may also be temporarily seen after the ingestion of a large proportion of saccharine food, in chloroform poisoning, in pregnancy, and in some infectious and nervous disorders.

Bile.—Bile in the urine (*chyluria*) is recognized by the dark, porter-like color it gives the urine. Urine containing bile will stain linen yellow. Its presence may be demonstrated by dropping a few drops of the urine from a pipet on a white tile, and adding a few drops of nitric acid. As the urine and the nitric acid mix, a play of colors is noticed, of which, to demonstrate bile, green must be one.

Indican.—The presence of indican in the urine is frequently of diagnostic importance. Indican is the product of indol, which is produced as a result of bacterial decomposition of food that has been long retained in the small intestine. A small quantity of urine is mixed in a test-tube with an equal quantity of hydrochloric acid, to which is added, drop by drop, a mixture known as *Labarraque's solution,* or liquor sodæ chlorinatæ (carbonate of soda and chlorinated lime). If indican is present, the mixture turns an indigo-blue color.

Acetone and **diacetic acid** when found in the urine are of diagnostic importance. Acetone is found in conditions of starvation, as in fevers and after operations; acetone and diacetic acid are common in the urine of diabetic patients and in that of children suffering from acidosis.

Test for Acetone.—To urine 5 c.c. in a test-tube add one crystal of sodium nitroprussid and a few drops of strong nitro-acetic acid; shake. Add sufficient ammonium hydroxid to render alkaline.

If acetone is present the specimen turns purple.

Test for Diacetic Acid.—To urine 5 c.c. in a test-tube add an excess of a 10 per cent. solution of ferric chlorid; if diacetic acid is present the specimen turns a dark brownish red *which will disappear on heating.*

A similar reaction in the urine may occur when certain

drugs, such as aspirin, are taken, with the difference that the reactionary color is not removed on heating.

Gravel.—A deposit of fine sand, sometimes reddish in color, is not infrequently found, usually in strongly acid urine. The urine is voided with pain. The deposit consists of small urinary calculi, composed of the salts of uric acid, and is not soluble by heat, as is the ordinary pinkish deposit of urine containing excessive urates. This sand deposit is usually termed *gravel.* Either persistent hyperacidity or alkalinity may result in the formation of calculi.

The urine of patients with typhoid fever should give what is known as *Ehrlich's diazo-reaction.*

To make this test two solutions are required. One is composed of sulphanilic acid, 5, hydrochloric acid (pure), 50, water, 1000; the second contains sodium nitrate, 0.5, to water, 100. The two are mixed together in a test-tube in the proportion of 50 c.c. of the hydrochloric acid solution and 1 c.c. of the sodium nitrate solution; an equal volume of urine is added to the mixed solution, and finally 1 c.c. of ammonia water. The whole is shaken until it froths. The reaction is present if the urine, *including the foam*, turns rose-red. The reaction has also been noticed in pneumonia, septicemia, and other conditions.

Chemical tests may also be used to test the proportion of urea in the urine. The *presence* of urea may be demonstrated by adding to a few drops of urine on a glass slide a drop or two of nitric acid. The acid will unite with the urea, forming crystals of nitrate of urea. Oxalic acid may be used instead of nitric acid in the same manner. Unless the specimen contains urea in excess, the urine must be allowed partially to evaporate by exposure before the acid is added. To estimate the *quantity* of urea, there are several complicated processes and special apparatus. The simplest one is Fowler's hypochlorite test for urea. The process is as follows:

"Add to one volume of the urine seven volumes of Labarraque's solution of chlorinated soda.

"Shake the jar containing the mixture thoroughly and stand it aside for two hours (*shaking occasionally*),

when the urea will have been decomposed. Now take the specific gravity of the quiescent fluid.

"Ascertain the specific gravity of the mixture of urine and Labarraque's solution before decomposition. To do this multiply the specific gravity of the pure Labarraque's solution by 7, add this to the specific gravity of the pure urine, and divide by 8. The result is the specific gravity of the mixed fluid. From this subtract the specific gravity of the quiescent mixture after decomposition of the urea, multiply the difference by 0.77, and the result is the percentage of urea" (A. A. Stevens, "Manual of Medicine").

In hospital work the examination of urine is carried on in the laboratories, and is rarely part of a nurse's duties. In the small hospitals, where there is no resident medical staff, and in private practice, she is, however, frequently required to undertake certain processes of the chemical examination. Before all operations, for example, the urine of patients is examined to determine especially the presence of albumin or sugar. There are several reasons for this examination, of which we may note the two principal. Ether is highly irritating to the kidneys; patients, then, already suffering from inflammation of the kidneys, as suggested by the presence of albumin, run an added risk in undergoing an operation where anesthesia is necessary. In this case chloroform is sometimes substituted as being less irritating, or the operation may be postponed until the kidneys are in a healthier condition. If the operation is performed, the after-treatment will be qualified by the condition of the kidneys. Patients with glycosuria are in most instances suffering from diabetes mellitus. In this condition the tissues are deficient in healing properties, and wounds are liable to be followed by gangrene; patients, therefore, with glycosuria are not considered favorable subjects for operative proceedings when such can be avoided.

The examinations of urine commonly asked of a nurse are to ascertain the specific gravity and the reaction of the specimen, and to apply the tests, as indicated above, for urates, phosphates, albumin, and sugar. Every nurse

ought to be able to carry out these simple tests accurately. Where an extraneous substance is found or suspected, the same specimen should be kept for verification by the doctor, as it does not always follow that the substance may be persistently present, or present in the same proportion.

CHAPTER VIII

BANDAGES AND SPLINTS

Bandages—Rests; Spiral, Reverse, Figure-of-8, Spica, Tortuous—Special Bandages—Heel, Foot, Hand, Stump, Eye, Barton, Neck and Brow, Breast, Capeline, Velpeau, T-, Jaw, Many-tail, Binder, Y-bandage, Handkerchief—Slings—Plaster-of-Paris, Sayres' Jacket and Jury-mast; Starch; Silicate of Soda; Wax—Splints—Applying, Pressure-sore; Straight, Back, and Angular Splints; Fracture-box—Special Splints—Bond, Levis, Thomas, Dupuytren, Hodgen; Inclined Plane; Gooches' Coaptation Splinting; Poroplastic Felt; Extensions, Restraint; Bradford Frame; Sand-bags; Cradles; Strapping—Applying; Special, for Ribs, Clavicle, Ulcers, Joints.—Knots—Granny, Reef, Surgeon's, Clove-hitch.

BANDAGES

In surgical work bandages are in constant use, and all nurses should know how to apply neatly and adequately the proper bandage for the proper circumstance. Bandaging is most satisfactorily taught in classes; dummy limbs, sand-bags, clubs, etc., may be used for the individual practice; in class the pupils should learn on each other, or on a convalescent patient, where one is found willing to serve.

Bandages are used for support, to apply pressure, or to retain splints, dressings, and applications in their place.

Two varieties are used—the roller and the handkerchief. Roller bandages are made of unbleached muslin, crinolin, gauze, flannel, or rubber. Crinolin bandages may be stiffened with plaster-of-Paris, starch, silicon, or wax.

Roller bandages are cut in lengths of, usually, 7 to 9 yards, and in widths of from 1 to 6 inches.

A different width is used, for convenience, for different parts of the body, thus:

Leg,	width,	3	inches;	length,	9	yards.
Arm,	"	2½	"	"	7	"
Head,	"	2½	"	"	6	"
Eye,	"	2	"	"	3	"
Finger,	"	1–1½	"	"	1	"
Ribs,	"	4–6	"	"	9	"

Bandages should be rolled tightly and evenly and all unravelings closely cut away. To keep the edges even, bandages of muslin, crinolin, and flannel are torn from the piece. Gauze bandages are usually obtained ready cut and rolled by machinery, but if to be prepared by hand, the gauze must be carefully cut by the thread. A bandage roller is generally used to roll bandages, and makes a firmer bandage than a hand-rolled one (Fig. 63). Gauze bandages are used to apply dressings, being cool and clean. Muslin bandages, being stouter, are better for applying splints, etc., or where support is required. A crinolin band-

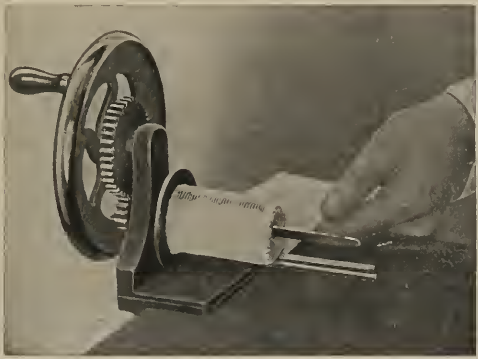


Fig. 63.—Hand roller-bandage machine (Fowler).

age, stiffened by one or other method, is practically both splint and bandage, and is used to insure immobility. Pressure may be applied by a flannel bandage or by a muslin bandage applied over an even layer of sheet cotton. Even pressure over the course of a vein, as in the treatment of varicose veins, is applied by the *rubber Esmarch bandage* directly on to the surface of the skin.

Position for Bandaging.—Before applying a bandage the patient must be placed in a comfortable position, with the part to be bandaged supported so that it can be easily reached and kept immovable without undue fatigue. **Rests** for the pelvis or the heel are obtained in metal or wood. A **U**-shaped piece of wood on a stout column

fitted on to a solid base is easily made, and forms a support for the ankle while the leg is elevated for bandaging. For the pelvis, the supporting piece should be flat, about 6 inches long and 4 wide, fixed at right angles to the supporting column. Sand-bags or pillows are practical substitutes if a rest is not at hand.

To support a leg by the hand, it should be lifted with one hand under the ankle and the other grasping the toes, keeping the foot at right angles to the leg. Speaking surgically, *the leg is that portion of the lower extremity between the knee and the ankle.*

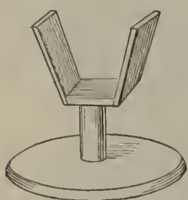


Fig. 64.—Leg rest.

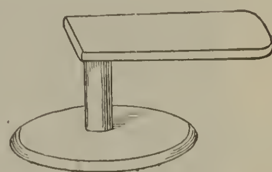


Fig. 65.—Rest for pelvis.

To support an arm the hand is clasped by one hand, the arm extended, and the other hand placed below the elbow.

To support the head, the shoulders, or the pelvis by hand, the nurse should place her elbow firmly on the bed and support the part with the palm of the hand. This position can be retained longer than any other attitude of lifting without fatigue or faintness, and keeps the part steadier.

Rules.—In bandaging (roller) a few rules must be remembered:

1. Stand directly opposite the part to be bandaged and bandage away from yourself.

2. Bandage from the inner to the outer surface of a limb and from below upward.

3. Fix the bandage with the first turn; cover with each subsequent turn two-thirds of the turn below.

4. Make no turn or knots over a bony prominence.

5. Unroll the smallest possible portion of the bandage

only, and keep the rolled portion firmly between the fingers and thumb.

6. Finish the bandage on the outside of a limb; use a safety-pin run through the long axis of bandage; a body bandage is pinned in front, and a head bandage over the temple.

To the second rule there are two exceptions: (1) In fracture of the femur the deformity is *eversion;* the bandage is applied from the outer to the inner surface to correct it. (2) A roller applied over the ribs is applied from above downward.

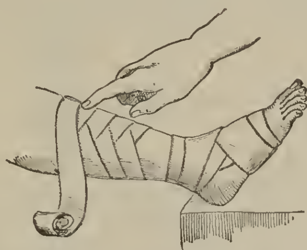


Fig. 66.—Spiral reversed bandage (Stoney).

Fig. 67.—Spiral reversed bandage of upper extremity (DaCosta).

Fig. 68.—Spiral reversed bandage of lower extremity (DaCosta).

To rule 3, the eye bandage and some form of head bandage are the exception; each turn in these bandages completely covers the lower turn.

A roller bandage is applied in three ways: the *simple spiral,* the *reverse* spiral, and the *figure-of-eight,* of which latter there are several modifications.

The **simple spiral** is applied by rolling the bandage obliquely round the member, each turn covering two-thirds of the turn below.

The **reverse spiral** is employed where, owing to the shape of the member, the simple spiral will not stay in place. At each round of the bandage a sharp turn or fold is made in the width of the bandage, as though it were going to be

cut on the bias; this gives the bandage an elasticity and enables it to fit more closely. To make the turn neatly, each exactly above the lower turn, the lower margin of the bandage is fixed by the thumb of one hand while the turn is made. In bandaging the leg the sharp shin bone can be taken as a guide, and the turn made to the outside of the bone. For the upper extremity, the arm should be held with the back of the hand uppermost, and the turns made exactly in the center.

The **figure-of-8 bandage** is used over joints and in the application of splints and dressings. It consists of a series of double loops round a limb or joint, starting in

Fig. 69.—Figure-of-8 bandage (Stoney).

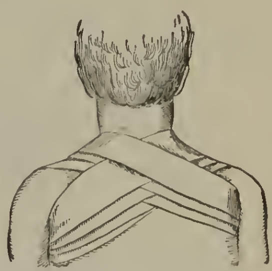


Fig. 70.—Posterior figure-of-8 of both shoulders (DaCosta).

front, carried obliquely upward round the limb or joint behind, and brought down again in front, crossing the lower turn so made. Each crossing, for appearance sake, is made directly above the one below.

Where the joint is at right angles to the body, as in the shoulder or the hip, one loop of the figure-of-8 is much larger than the other, but the principle of double loops crossing in front is the same. Such a bandage is called a *spica*.

The **shoulder spica** is fixed first by a few spirals round the upper arm. A loop is then taken passing across the back, under the opposite axilla, and, returning over the chest, is crossed on the outer surface of the upper arm; the smaller loop passes round the arm. The turns are continued until the point of the shoulder is well covered.

The Pelvic Spica.—In the same way the pelvic spica bandage has the smaller loop round the thigh, and the larger loop round the pelvis. The turns cross in front of the thigh toward the outer side. It is fixed more securely

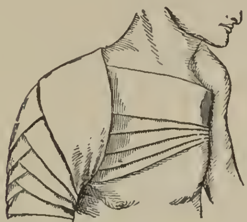


Fig. 71.—Spica of the shoulder (DaCosta).

Fig. 72.—Spica of the groin (DaCosta).

by taking the first turn round the pelvis. Where both shoulders or both hips are to be bandaged, the double spica is used. The large loop round the trunk is interrupted to take a second loop round the opposite joint; the loops round each joint are made alternately, the bandage forming the loop round the body between either joint.

Fig. 73.—Figure-of-8 bandage of the instep (DaCosta).

Fig. 74.—Spica of the instep (DaCosta).

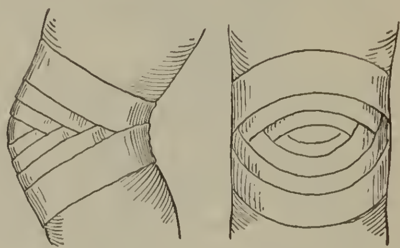
The **foot** is bandaged by a series of figure-of-8 loops passing round the foot and round the ankle. The first turn is fixed round the ankle, and the bandage then brought round the roots of the toes, each subsequent loop covering two-thirds of the loop below it.

The **hand** is bandaged by a series of figure-of-8 loops passing alternately round the hand and round the wrist.

Bandaging the Fingers.—In bandaging the finger the tip is covered by carrying the bandage to and fro over the tip; the folds so made are held in place until fixed by a series of simple spiral turns. If several fingers are to be bandaged separately, each finger bandage is secured in turn by a figure-of-8 loop round the wrist. Usually it is more practical to pack plenty of dressing between the fingers and bandage them together with the hand, using figure-of-8 loops.

The thumb is bandaged with a spica, the loops alternately round the wrist and round the thumb, starting from the base.

Fig. 75. — Spica of thumb (DaCosta).



a *b*

Fig. 76.—Tortuous bandage for knee: *a*, Side view; *b*, from above.

Tortuous Bandage.—Where a joint is to be kept flexed, a modification of the figure-of-8 bandage, known as the *tortuous* bandage, is used. Instead of each turn covering partially the turn below it, the first turn is taken on the angle of the joint, and a series of loops are then made alternately above and below the first turn, which is the fixed point. The loops above the fixed point are taken one above the other, the lower loops one below the other.

Bandaging the Heel.—In bandaging the heel, the tortuous bandage is used. To fix it a loop is taken starting from the outer malleolus, passing below the heel, across the instep, and round the ankle. The first turn of the tortuous bandage is then taken over the point of the heel,

then below and above, as many loops as are necessary until the heel is covered, the cross-turns showing on either side of the foot. Practice is required to bandage the heel securely and neatly.

Bandaging a Stump.—In bandaging a stump the end is first covered by carrying the bandage to and fro. The

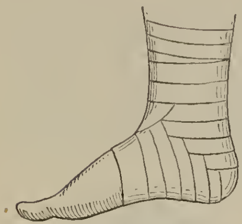


Fig. 77.—Method of covering the heel.

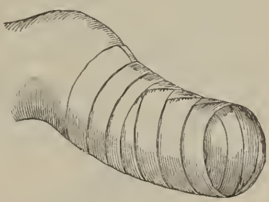


Fig. 78.—Recurrent bandage of a stump (DaCosta).

center is taken as the starting-point, and the bandage carried to right and left alternately, each turn covering two-thirds of the turn next. The turns so made are held in place by the left hand. When the end of the stump is covered, the ends are secured by a figure-of-8 bandage or a simple spiral carried up as high as necessary.

An **eye bandage** should be light and firm. The bandage consists of alternate loops taken, the first one round the head at the temples; the second, passing from the temple behind the head, under the opposite ear, is brought up over the cheek, covering the eye, and crossing the root of the nose to the temple again. Some oculists order pressure to be made downward in bandaging the eye. The second loop is then applied in reverse order from the temple across the eye and cheek and under the ear, finally over the back of the head, to the point from where it

Fig. 79.—Figure-of-8 of one eye (Stoney).

started. As a rule, in an eye bandage each turn exactly covers the one below unless a dressing has to be covered in. In this case each head turn is completely covered, while each turn over the eye covers two-thirds of the one below. Both eyes may be bandaged together. The bandage starts from the right temple, is brought down over the left eye, under the left ear, across the back of the neck, under the right ear, up over the right eye, to the left temple; half a turn round the head brings the bandage back to the right temple, from where it starts again. The turns cross over the root of the nose; when complete, a couple of turns are taken round the head to fix the bandage.

Fig. 80.—Crossed figure-of-8 bandage of both eyes (DaCosta).

Fig. 81.—Barton's bandage, or figure-of-8 of the jaw (DaCosta).

Bandaging the Jaw.—To bandage the jaw a modification of the figure-of-8, known as the Barton bandage, is used.

The first turn begins immediately below the occiput, passes up the head behind the right ear, and over the crown to the left temple; continuing, the bandage is carried down the cheek in front of the left ear, *under* the chin, and up the cheek in front of the right ear, over the crown, and crossing the first turn back to the starting-point. The second turn passes round the back of the neck under the right ear, and *over* the chin back to the base of the occiput. The turns are repeated as often as necessary, each completely covering the one below. The bandage should finish on the crown.

Nape of the Neck.—In applying a dressing to the nape of the neck a figure-of-8 is applied, the loops alternately round the neck and round the brows, crossing at the occiput. If the dressing covers the ears or submaxillary glands, the loops are made alternately from the nape round the brows and from under the chin, over the crown, half a turn being taken round the neck between each loop.

To **support the breast,** a figure-of-8 bandage is applied, one turn round the waist, the second carried upward under the breast to the opposite shoulder, downward across the back, under the axilla, on the side from which the bandage started to the starting-point, and again

Fig. 82.—Crossed bandage of the angle of the jaw (DaCosta).

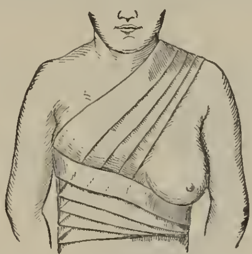


Fig. 83.—Figure-of-8 bandage of the breast (DaCosta).

round the waist. The turns are repeated as often as necessary, each turn covering two-thirds of the turn below and crossing below the breast.

The two breasts may be bandaged at the same time. The first turn having passed over the right breast, as already described, the next turn is taken upward under the outer margin of the left breast and under the left axilla to the back, across the back over the right shoulder, and down under the inner margin of the left breast; half a turn round the body then brings the bandage back again to the starting-point.

Capeline Bandage.—To cover the round ball of the head neatly requires practice. The ends of two bandages $2\frac{1}{2}$ inches wide are sewn flatly together, or one bandage 10

yards long may be rolled from either end, forming a double roller bandage. Standing in front of the patient, the two rollers are rolled from the center of the forehead to the back of the occiput and crossed. The under roller is next brought directly back to the center of the forehead, over the crown of the head; the second roller is brought round the head over the temple, passes over the first roller in the center of the forehead, fixing it, and is continued round the head to the occiput. The first roller is doubled back over the crown and fixed at the occiput by the second roller in the same way. These turns are then repeated, the first roller going obliquely alternately to the right and left of the first point covered, and overlapping two-thirds of the turn immediately

Fig. 84.—Recurrent bandage of the head (DaCosta).

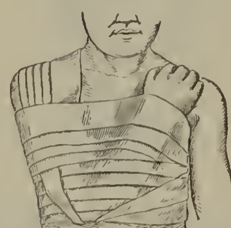


Fig. 85.—Velpeau's bandage (DaCosta).

below, the second roller fixing the first at the occiput and forehead. If the turns of the first bandage are neatly made, they are shown to cross in front of the crown, and behind over the occiput.

Velpeau's bandage, for fractured clavicle or collar-bone, is one in fairly frequent use which a nurse should know how to apply.

A pad or folded towel is placed in the axilla of the affected side, and the hand brought up and made to grasp the sound shoulder; the point of the elbow should be in front of the sternum; the site of fracture is protected by a pad; the chest is well powdered, and covered with a towel on which the arm rests. The bandage is applied by a

series of double turns, after first fixing by two turns round the chest. The bandage starts from the axilla on the uninjured side, is carried across the back over the injured shoulder, down over the middle of the upper arm and behind the elbow, across the chest, to the starting-point; the second turn is carried straight across the back round the chest, over the flexed arm, and so back to the starting-point. The downward turns advance from the middle of the arm until the elbow-point is covered, each turn overlapping two-thirds of the turn below; the straight turns cover the elbow-point first, and are carried as high up the arm as is necessary, each turn also overlapping half of the turn below.

The roller bandage is used in making the T-bandage, the four-tailed bandage, and the many-tailed or Scultetus bandage.

The **T-bandage** is used to retain perineal dressings and pads. It is made from two pieces of a roller bandage

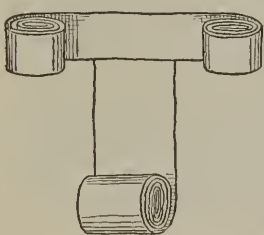


Fig. 86.—T-bandage.

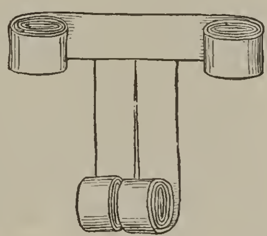


Fig. 87.—T-bandage divided.

4 inches wide. One piece 1 yard long is folded and stitched, forming a belt 2 inches wide. A second piece is cut, 2 yards long, doubled in half, and stitched, forming a strip a yard long by 4 inches wide. The wide strip is sewn to the center of the narrower, forming a T, of which the arms are fastened round the waist, while the tail comes from behind over the perineum, and is slipped under the belt in front and pinned. Frequently the wide strip is divided down the center to half its length. The two tails so formed are brought up between the legs and fastened to the belt on either side of the abdomen.

The **four-tailed bandage** is used for the lower jaw. A length one yard long of a 4-inch roller bandage is required. Exactly in the center a small hole is cut. From each end the strip is torn down the center of the width, to within a couple of inches of the hole. The hole is placed over the point of the chin; the strips thus placed

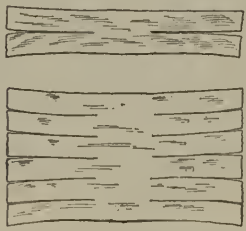


Fig. 88.—Four-tailed and many-tailed bandages (Stoney).

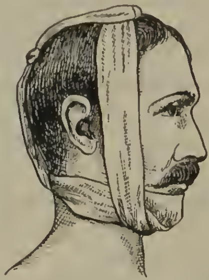


Fig. 89.—Four-tailed bandage for the jaw (Stoney).

uppermost are then tied under the occiput with a single knot pulling the jaw back; the lower strips are brought from under the chin in front of the ears and tied on the crown with a single knot, thus pulling the jaw upward; the bandage is secured by tying each end of the lower strip to one of the upper strips in a bow-knot.

Fig. 90.—Scultetus bandage (Stoney).

The **many-tailed** or **Scultetus bandage** forms an elastic, close-fitting bandage for the abdomen, and is commonly used after abdominal operations. Six or eight strips of bandage, 4 inches wide and a yard and a half long, are placed one above the other, each overlapping two-thirds of the one below. Three rows of stitching, one in the center and the others three inches to either side, keep the strips in place, or they may be stitched down on to a wide piece of bandage.

To apply, the bandage is rolled from either side to the center and slipped below the patient's back. The strips

are then unrolled and brought, alternately right and left, obliquely across the abdomen and tucked firmly in on the opposite side, each strip crossing the opposite strip in the center. The bandage is usually applied from above toward the pubes. The two lower strips are pinned in front, or they may be brought upward to opposite sides of the bandage and pinned to the upper margin. In using the bed-pan or attending to the back these two strips can be unpinned and turned back without displacing the bandage. A T-strip may be added to the Scultetus;

Fig. 91.—Many-tailed bandage for the abdomen (Fowler).

brought over the perineum and pinned in front, it serves to keep the bandage from slipping upward.

A many-tailed bandage may also be used for the spine or for a limb, where it is desirable not to disturb the part by lifting.

Binders.—For support or in order to retain dressings, etc., on abdomen, chest, or spine, a binder is frequently more practical than a roller bandage. A binder may be made of a double piece of stout muslin, flannel, or roller toweling; it should be about 12 to 18 inches wide and long enough to go easily once and a half times round the body.

An **abdominal binder** is generally used in obstetric cases in preference to a Scultetus. It is fastened exactly in front with safety-pins set closely together. The lower margin should be four inches below the trochanter, the upper margin about the waist-line. To make the binder fit closely darts are made at the waist-line and below the hip in front, with closely set safety-pins. The binder should fit without a wrinkle and be neat in appearance.

Fig. 92.—Abdominal binder and breast binder in place (Dickinson, from a photograph).

Breast Binder.—The same binder may be used for the breasts, either to supply pressure or to retain dressings. The bandage is pinned in front, and darts pinned as necessary on either side below the breasts and above. Straps attached to the binder behind are brought over the shoulder and pinned in front to keep the binder in place.

A modification of this bandage is made by cutting the binder with arm-holes and shoulder-pieces. The shoulder-pieces are pinned when in place, and the darts taken below each breast with either bandage. The breasts

should be surrounded, covered, except immediately over the nipples, with a generous layer of cotton, and the binder kept tightly pinned. There should be no pressure directly on the nipples.

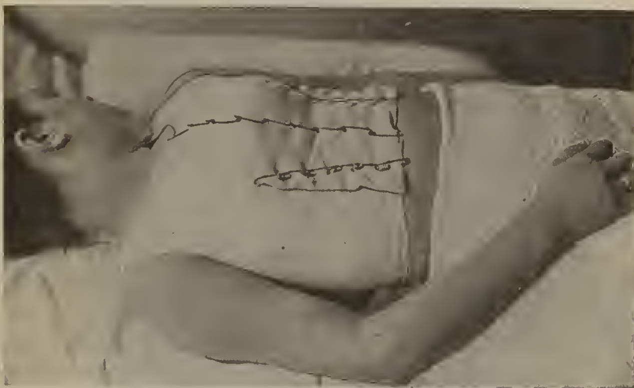


Fig. 93.—The breast binder applied (De Lee).

Y-shaped Binder.—Some obstetric hospitals use what is known as the Y-shaped breast binder. This is made of two hand-towels folded lengthwise in four. One of the folded towels is then doubled in a bias fold and pinned with closely set safety-pins to one end of the straight towel, forming the Y. When applied the tail of the Y is carried round the back, the arms of the Y are brought firmly one above and one below the breasts, and pinned to the tail on the opposite side. The breasts must be well packed with cotton, and the bandage applied so as to press the breasts from above and below between the upper and under arm of the bandage. The nipples are free from pressure. The free end of the tail may be pinned across the chest, but is not used to exert pressure. The bandage is applied as tightly as possible.

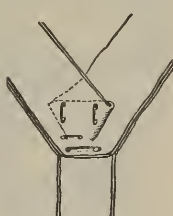


Fig. 94.—Y-bandage.

The **handkerchief** or **triangular bandage** is more used

in emergency work than in hospital nursing, but is often useful where dressings, etc., have to be frequently changed.

Fig. 95.—The H-bandage (Boston Lying-in Hospital) (American Text-Book of Obstetrics).

A piece of muslin a yard square, cut across or folded diagonally, makes a triangular bandage of suitable size.

Fig. 96.—Handkerchief bandage for perineum and hip (Stoney).

Fig. 97.—Three-cornered bandage for arm (Stoney).

Fig. 98.—Four-cornered bandage for arm (Stoney).

To apply to the *head*, the center of the diagonal margin is laid across the forehead, the point of the handkerchief

hanging behind. The two ends are crossed above the tail below the occiput, brought up on either side of the head, and tied over the forehead. The point is brought up from behind and pinned on the top of the head.

Fig. 99.—Triangular bandage of the head.

The handkerchief may also be used for the *foot* or the *hand*. The member is laid in the center of the bandage, the longer margin or base of the triangle round the wrist or ankle. The point is brought from behind over the front of the foot or the back of the hand, and the two ends crossed over the point, passed round behind, and brought up and tied in front in a surgical knot (see below). The point is folded back and pinned below the knot. The triangular bandage is easily folded as small as required.

A *stump* may be bandaged in the same way. In applying a handkerchief to the *shoulder* or *hip* the lower margin

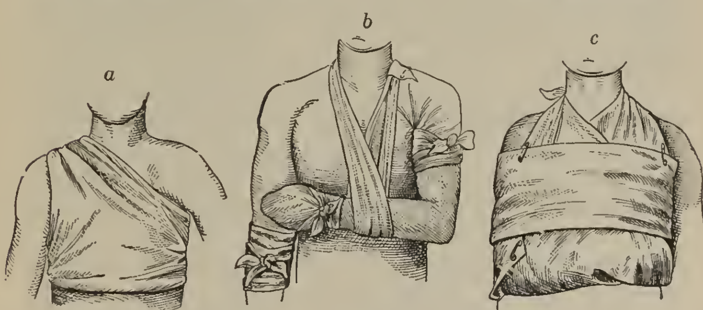


Fig. 100.—Various forms of handkerchief bandages: *a*, For the chest; *b*, for the shoulder, hand, and arms; *c*, double bandage to prevent motion of the arm (Stoney).

or base is passed round the upper arm or the thigh, and tied in front, the point of the handkerchief lying uppermost and in front. A strip of roller bandage or a second handkerchief folded into a band is tied respectively round the waist or round the neck and opposite axilla. The

point is slipped beneath the band so formed and pinned over.

The handkerchief is in common use as a *sling* for the support of the arm. Laying the forearm in the center, the hand at the lower margin or base, and the point over the elbow, the two ends are tied behind the neck, the end of the half lying outside the arm passing round the opposite side of the neck. The point is brought over the elbow and pinned in front. Where the wrist alone is supported, the handkerchief is folded into a strip and tied behind the neck in the same way.

A **stiff bandage** is frequently necessary to insure immobility, as in the treatment of fractures, dislocations, or diseased joints, or following operations for deformities.

PLASTER-OF-PARIS BANDAGE

Plaster-of-Paris is the stiffening most commonly used. Plaster bandages are made of crinolin, muslin, or a loose-meshed coarse muslin. If crinolin is used, the plaster is retained better if the pieces are washed and mangled before the bandages are torn. The bandages are cut usually 5 yards long and rolled. Well-dried plaster-of-Paris is then rubbed thoroughly into the bandage, unrolling a few inches at a time, and rolling again, but not too tightly. A bandage roller fitted over a shallow box filled with the plaster is a practical apparatus for rolling the bandage quickly. Each bandage is wrapped separately in oiled paper to exclude the air, the moisture from which readily absorbed by plaster of Paris, will ruin the bandage; as a further precaution, the bandages should be stored in an air-tight tin box and kept in a warm, dry place.

Technic.—Before applying a plaster bandage the limb is well washed, dried, and powdered, and protected by a preliminary bandage of flanelette, of shaker flannel, or by strips of raw sheet cotton, applied like a bandage.

In applying, the bandage is dipped into water, hot water causing the plaster to harden or set more quickly than cold. Salt, $\frac{1}{2}$ ounce to the quart, added to the water also hastens the process of setting. The water should be sufficiently deep to cover the bandage placed upright, in

which position the water percolates most thoroughly. It must be applied directly it is saturated and before the plaster has time to set. The bandage is ready for use, and should be taken out of the water directly no more air-bubbles are seen to escape. It is then gently squeezed and applied evenly in a simple spiral. A cream of the plaster, made of equal parts of water and plaster, is rubbed evenly over the applied bandage to improve the appearance.

The plaster must be left exposed until quite dry, and care taken that the required position is retained until the bandage is hard. Before it is too hard, a line is cut with a sharp knife down the center of the bandage, in order that the cast may be removed when necessary. To protect the patient a narrow, flat strip of metal is usually placed under the first turn of the plaster bandage and the cutting is made over it. If the plaster has not been cut before hardening, the line of incision may be softened with vinegar or with dilute hydrochloric acid. A vegetable knife makes a good cutting instrument for the purpose, or a special pair of shears, known as plaster shears, may be used. This consists of a cutting blade which cuts downward onto a narrow metal plane, the plane being slipped under the turns of the bandage.

Opening in Bandage.—It may be necessary to make an opening in the plaster cast over a wound, in order to change a dressing without removing the splint. In the case of small openings, a thumb tack may be inserted in the first turn of the plaster bandage, the point turned outward exactly in the center of the proposed opening. When the bandage is completed, the sharp point can be felt, and the required circle cut round it.

For **large dressings** involving, for example, an entire joint, an *interruption* is usually made. The bandage is applied in two parts, above and below the dressing. Strips of metal, usually covered in rubber, are used to connect the two parts, and are fixed in place by the turns of the bandages. The metal strips are arched so as to give plenty of room for the dressings.

Bony prominences should be padded with cotton before applying a stiff bandage. After applying such a bandage

to an extremity the fingers and toes, which are purposely left uncovered, should be examined from time to time. If they appear blue or cold, or the tissues immediately below the bandage become swollen and edematous, the bandage is too tight and must be cut.

To insure greater rigidity, the plaster bandage may be braced by thin strips of metal, wood, or card-board, held in place by the turns of the bandage.

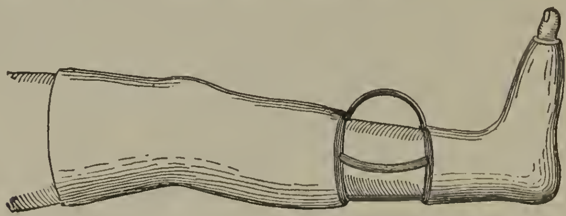


Fig. 101.—Interrupted plaster-of-Paris case (DaCosta).

Sayre's Spinal Jacket.—In applying a plaster cast to the spine in the treatment of spinal curvature (known as Sayre's jacket), it is necessary that the spine should be extended during the process. To do this an apparatus usually known as the *gallows* is used (Fig. 102).

This consists of a tripod, from which hangs, by a pulley, a wooden cross-bar; from the cross-bar are suspended a padded leather collar shaped to support the chin and occiput, and a pair of padded loops through which the arms are thrust. The patient supported thus, traction is made over the pulley until the patient is raised on his toes. A woven sleeveless jersey is worn next the skin: the bony prominences and, in a female patient, the breasts, are well padded, and a folded towel is placed over the stomach, forming a " dinner-pad," which is removed after the bandages are set. The bandages are usually 6 inches wide for an adult and 4 for a child. They are applied evenly round the trunk, from below the crest of the ilium to the axilla. Before drying an incision is made down the front, so that the cast can be readily removed. The opening may be neatly bound with strips of thin leather, to which hooks are attached, so that the jacket may be

laced. Otherwise the jacket is kept adjusted by a few turns of a muslin bandage.

The object of the Sayre jacket is, by extending the spine, to keep the inflamed surfaces of the vertebræ apart, and to throw the weight of the body on to the pelvic bones instead of the spinal column. Where complete extension is necessary, the jacket is reinforced by an apparatus known as Sayre's *jury-mast.* This consists of a padded collar supporting the chin and occiput, fastened by straps to a fixed steel support which comes from the back and is

Fig. 102.—Applying a plaster-of-Paris jacket (Sayre).

Fig. 103.—Plaster-of-Paris jacket and jury-mast applied (Sayre).

arched above the head. The steel is attached to a brace worn round the body, or if the plaster jacket is also used, it is kept in place by the turns of the plaster bandages.

A **starch bandage** is less heavy than a plaster bandage, but, as it is also less rigid, it is not so frequently used.

The part is first protected by a single bandage of flannelette or shaker flannel. A gauze bandage loosely rolled is then dipped into a basin of laundry starch prepared in the usual way, gently squeezed free of superfluous moisture, and applied evenly in figure-of-8 turns. As many layers as

are necessary are applied over the first. A starch bandage takes comparatively long to dry. As it is soft until quite dry, sand-bags must be placed to insure the position being retained, and no movement permitted.

Water Glass.—A solution of silicate of sodium (or water glass) is also used to form a stiff bandage, especially for the extremities. It is also light, but more rigid, than a starch bandage. A flannelette or shaker flannel bandage is first applied, and over it a gauze bandage, in figure-of-8 turns. The silicate is then painted over the bandage with a painter's brush. A few minutes are allowed for partial drying, and the next bandage applied in the same way. Four to six bandages are usually necessary. The silicon bandage also takes long to set—usually not less than twenty-four hours. The drying may be hastened by hot-water cans.

Wax bandages are not much used at the present day. They form light, rigid bandages, especially suitable for young children, and have the advantage that they become less readily impregnated with urine or fecal matter than plaster-of-Paris. They are used chiefly for the extremities, to retain splints in the treatment of fractures and diseases of the joints. Paraffin wax is used, heated to melting-point. Loosely rolled muslin (not gauze) bandages are soaked for a few moments in the wax, and applied quickly before the wax sets. Absorbent cotton is also soaked in the wax and used for the padding. Each bandage should not be more than 3 yards long, otherwise the wax will have cooled before the entire bandage is applied. The limb is first protected by a light flannelette bandage.

SPLINTS

A splint is an appliance for securing local immobility in the treatment of accidents or disease of the bones and joints, and for the correction of deformities of the extremities. Ordinarily, splints are made of wood or of metal; hard rubber, stiff felt, and card-board are materials also frequently used.

Padding Splints.—Metal splints which are usually

in special shapes, are covered, when padding is necessary, with leather or with chamois leather.

Wooden splints require to be thickly padded with tow or non-absorbent cotton. To make the pad, a strip of unbleached muslin or old linen is cut four times the width of the splint. A smooth layer of unbleached raw cotton, and sufficient tow pulled evenly to form a thick pad, are laid on the strip, and the edges are folded over and tacked together. The pad is then laid on the splint (the sewn surface next the splint) and sewn in place by a herring-bone stitch in stout linen thread across the back of the splint. The ends at the top and bottom are turned over and neatly sewn.

In an emergency the padding may be quickly bandaged to the splint, but the better way is the more comfortable, as it less readily becomes wrinkled or lumpy.

Besides the padding, small pillows, a few inches square, made of muslin stuffed with tow and non-absorbent cotton, must be used to protect bony prominences, such as at the ankle, the knee, or the elbow. In applying a splint to the leg a small pad should be placed *above the heel*, sufficiently thick to prevent the heel resting on the splint.

Pressure-sore.—Undue pressure from a splint may produce a pressure-sore, which, in origin and appearance, is similar to a bed-sore. The preliminary symptoms of heat, aching, or pain must never be disregarded. On the first indication the splint should be removed, the part rubbed with alcohol, and protected from further pressure by careful padding. When a pressure-sore has once formed, it is treated in the same way as a bed-sore.

Preparation.—Before applying a splint the limb should, if practicable, be well washed and thoroughly dried and powdered. If strapping is to be used, it should also be shaved. If abrasions are present, they are usually dressed with powdered zinc or with zinc ointment, and covered with gauze. A blister is pricked with a sterile needle, the fluid gently pressed out without removing the cuticle, and covered with absorbent cotton.

Splints are kept in place usually with bandages of stout muslin, and two or three strips of adhesive strapping.

In many cases more than one splint is used for the limb, as, for example, in back and side splints (see below), or in putting up a fracture of the forearm. In such cases, to avoid a second bandage, the outer splints are kept in place by tapes, or more neatly by straps of narrow webbing furnished with small buckles.

Rules.—A few general rules in applying splints are applicable in the majority of cases, and should be borne in mind:

1. The joint above and below the seat of injury should be at rest.

2. The fingers and toes should be left exposed; their color and warmth are indications of the condition of the circulation; if they turn blue or cold the bandages should be removed.

3. A bandage should not be applied under a splint when it can be avoided; if one is essential, it must be put on loosely and lightly.

4. In fracture cases the bandage is not usually applied directly over the seat of fracture.

Immobilizing.—Unless the splint is very heavy, some further means are generally necessary to keep a limb at absolute rest. Sand-bags, one on either side, may be used, or one sand-bag to which the splint is tied; in the case of a lower extremity, the leg may be swung in a cradle (see below). An arm is usually most conveniently tied on to a pillow.

A splint must be constantly examined to see that the desired position is exactly maintained.

The splints in common use are the straight splint, the back splint, and the internal and anterior angular splints. They are usually made of pine or oak.

The **straight splint** is cut to a convenient length from a board $\frac{1}{4}$ to $\frac{1}{2}$ inch thick, and from 3 to 6 inches wide. It is used for a variety of purposes. In short lengths it is a convenient method for keeping a single joint at rest, as the elbow, the wrist, the knee, for which purpose it is generally applied to the flexor surface. A couple of straight splints applied to the inner and outer surface of the forearm is a common method of putting up fractures

of the forearm. The inner splint is bandaged to the arm, and the outer splint kept in place by straps and buckles. The splints extend from beyond the elbow to the roots of the fingers.

In conditions where complete immobilization of the whole lower extremity is necessary, as in fractures of the femur, a straight splint may be applied outside the limb, extending from the axilla to beyond the foot. It is generally known as a **long splint.** The splint is kept in place with a wide rib roller round the body, and a figure-of-8 bandage from the foot to immediately below the seat of injury (or disease). Frequently the long splint is used in connection with a Buck's extension (see below). In this case the limb is not bandaged to the splint, but kept in place by three ties applied one above the knee, one below the knee, and one above the ankle. A straight splint

Fig. 104.—Straight splints applied to a fractured arm (Stoney).

is also used in injuries to the upper extremity, where the arm is fully extended.

The **back splint** consists of a straight splint to which a foot-piece is attached at right angles. It is used in the treatment of injuries and disease of the leg or foot. In fractures of the leg the splint must be sufficiently long to extend beyond the knee and keep the joint at rest. In applying, a couple of strips of adhesive plaster are generally used under the bandage, one below the knee and one above the ankle. In order to minimize pressure on the heel the splint usually has an opening cut in the back piece, at the point where the heel rests, and a small pad is placed immediately above the heel. The heel is left unbandaged, in order that the heel pad can be readily adjusted, if necessary.

Where immobility is an essential part of the treatment, as in a fracture, a pair of straight splints are also used,

one on either side of the back splint, and commonly known as *side splints*. The leg is bandaged to the back splint, and the side splints are kept in place by straps and buckles. The side splints can be removed and reapplied without disturbing the limb.

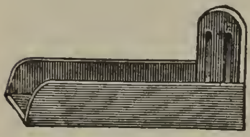


Fig. 105.—Box-splint (DaCosta).

Fig. 106.—Internal angular splint (DaCosta).

Box Splint.—This is a modification of the above, and consists of a back splint, to which the side splints are attached by hinges (Fig. 105). A thick pillow is used as a pad, and the whole is kept in place by webbing straps.

Fig. 107.—Internal angular splint in fracture of the shaft of the humerus (DaCosta).

The **angular splint** is used in the treatment of the upper extremity, where it is desirable to keep the elbow flexed and at complete rest.

The **internal angular splint** (Figs. 106, 107) consists of a couple of straight splints joined at right angles, one arm considerably shorter than the other. It is applied to the internal surface of the upper extremity, held with the elbow flexed; the short arm reaches from the axilla to the elbow, the long arm from the elbow to the roots of the fingers or beyond as desired. The internal angular splint is used in fractures and injuries to the upper arm.

The **anterior angular splint** (Figs. 108, 109) is made of two pieces of wood, deeply grooved, and joined at right angles, and is applied to the anterior surface of the flexed arm; that is to say, the bend of the arm fits into the groove. In this position the point of the elbow is outside the splint. It is used in the treatment of injuries accompanied by dislocation of the elbow or injuries at or near the elbow.

Splints for the upper extremity should be as light as is consistent with strength; those for the lower extremity are more solid; if of wood, the latter should be at least ½ inch thick.

Fig. 108.—Anterior angular splint (DaCosta).

Numerous special splints are in use, both in connection with general and with orthopedic surgery, especially devised for the maintenance of special positions. Usually they are made in sheet iron, tin, or aluminum, and are padded with leather, chamois leather, or outing

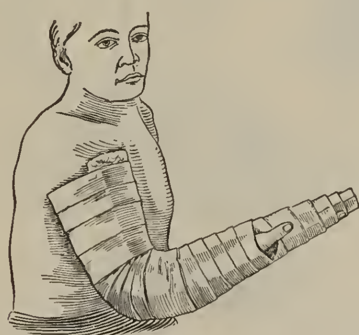


Fig. 109.—Anterior angular splint for fractures near the elbow-joint (DaCosta).

flannel. To fulfil their function they must fit the part and be carefully adjusted; usually they are kept in place by straps and buckles. Such splints are frequently called by the name of the surgeon who originally employed them.

Frequently, in hospital work, from motives of economy, plaster-of-Paris bandages take the place of special splints in orthopedic work.

Bond's splint (Figs. 110, 111) is used in fracture of the lower end of the radius (Colles' fracture, p. 622). This is a flat light splint, made of wood, the sides curved to the shape of the forearm and fitted with leather edges about

Fig. 110.—Bond's splint (DaCosta).

an inch high. Where the palm rests is a rounded block of wood forming a comfortable support. The splint is applied to the inner surface and extends from the elbow to the roots of the fingers. The fingers are flexed over the rounded block. A light straight splint is usually applied to the outer surface of the forearm.

Fig. 111.—Bond's splint in Colles' fracture (DaCosta).

Levis Splint.—This is somewhat similar to the Bond, and is also used in the treatment of Colles' fracture. It is made of perforated metal and grooved to fit closely to the under surface of the arm. A molded curve supports the palm and the ball of the thumb, in the same way as the wooden block of the Bond splint.

Thomas' hip splint (Fig. 112) or brace consists of three bands or girdles of metal on a narrow iron splint extending from the shoulder to the middle of the leg. One band encircles the body under the arm; another, the middle of the thigh, and the third, the calf of the leg. The bands are brought together with straps and buckles, and the splint kept in position by a brace over the shoulder. The limb is bandaged to the splint from the lower support to the hip. It is used in the treatment of the chronic stage of

Fig. 112.—Thomas' posterior splint.

Fig. 113.—Thomas' knee-splint.

hip disease, where the patient can get about with crutches. To keep the affected limb entirely off the ground, a thick sole or an iron patten is worn on the foot of the *sound limb.*

Thomas' knee splint (Fig. 113) or brace is made of two steels connected at the upper end with a padded metal ring, and ending at the lower end in a steel patten. A piece of leather or stout muslin is sewn to either steel to form a hammock-like support for the limb, extending several inches above the knee, and as far below as the ankle. The limb is passed through the padded ring, which fits closely round

the hip under the perineum, and supports the pelvic bones on the affected side. A brace over the shoulder keeps the splint in place. The leg is bandaged into the splint from the ankle to several inches above the knee. In standing, the weight of the body is carried by the splint from the pelvic bones to the patten, thus keeping all weight from the knee. A thick sole or patten is worn on the sound foot. The splint is used chiefly in chronic tubercular affections of the knee-joint.

Dupuytren's splint (Fig 114) is by many surgeons preferred in the treatment of a special fracture of the lower end of the fibula, known as Pott's fracture (p. 622), of which a characteristic symptom is the dislocation outward of the foot (eversion). The splint consists of a short, thick, wide board, with notches for the attachment of a bandage or strapping at the lower end; when applied, it extends from the knee to several inches below the foot. A very thick

Fig. 114.—Dupuytren's splint in Pott's fracture (DaCosta).

pad covers the upper part of the splint, ending where the internal malleolus (or ankle bone) would rest. Below this, the padding is just sufficient to avoid pressure—usually merely a few thicknesses of a flannel bandage.

The splint is applied to the inner side of the leg, the ankle placed in position over the thick pad, and held by a muslin bandage applied in a figure-of-8 round the ankle and foot, and each turn kept from slipping by being passed round the notches. A second bandage is applied from above the fracture to the knee. The object of the position is to correct the eversion of the foot. The patient lies on the side, with the knee flexed, the splint resting on the mattress and kept immovable by sand-bags. The position is usually found very fatiguing.

Hodgen's splint is sometimes used, in combination with an extension, in the treatment of fracture of the upper third of the femur. It consists of two parallel pieces of thick wire, across which strips of webbing are sewn at intervals

to form a sling. Cross-pieces of wire at either end, and a third about the middle, keep the splint in shape. The splint, when applied, reaches from above the fracture to below the foot, the whole limb resting on the webbing strips as in a shallow trough. At the knee the splint is slightly bent, so that when resting on the splints the

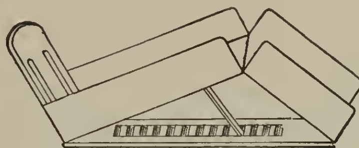


Fig. 115.—Double inclined plane (DaCosta).

thigh is flexed and the leg is extended. A Buck's extension (see below) is applied from the knee and fastened to the lower cross-bar. Cords and pulleys are also attached to the sides of the splint, one pair below the fracture and the other about the ankle, by means of which the whole limb is suspended to an upright support at the bottom of the bed.

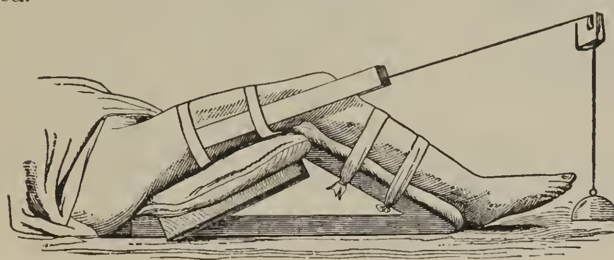


Fig. 116.—Fracture of the femur in the upper third with extension upon a double inclined plane (Agnew).

The Inclined Plane.—This is used in fracture of the patella when it is necessary to keep the knee immovable, with the leg extended, and at the same time to relax the muscles of the thigh. It consists of a long back splint attached by a hinge at the upper end to a frame which rests on the bed; the frame is provided with grooves into which a rest attached to the under surface of the splint may fit, thus elevating the foot to the degree necessary.

The position described under Hodgen's splint may also be attained by the *double inclined plane*. It is made like the simple inclined plane, with the addition that the posterior splint is made in two parts, fitted together by a hinge, so that the knee can be bent. It is also frequently used, with or without the extension, in the treatment of fractures of the femur, especially of the upper and lower thirds. (Fractures of the middle third are usually treated with extension, and the limb kept straight by sand-bags or the application of a straight side splint.)

Fig. 117.—Gooch's coaptation splinting (Scudder).

Gooch's coaptation splinting consists of a sheet of waxed canvas to which are attached long parallel straps of thin pine wood, about ½ inch wide. They may be cut to any size, and make a serviceable application where a light rigid splint, with some lateral molding, is desired.

Poroplastic is the name given to a felt saturated with a preparation of rubber which melts on exposure to heat; splints of this preparation are used where the deformity requires the splint to be closely molded to the limb. A piece of the prepared felt is soaked until soft in hot water, and then molded on the limb to the required shape, which, when dry, it retains.

EXTENSION

In connection with chronic joint disease, fractures, or dislocations, an appliance known as an extension is frequently used. Its purpose is, by the employment of continuous traction, to keep inflamed surfaces apart and at rest.

Buck's extension apparatus consists of a stirrup, a pulley and its attachments, two strips of adhesive strapping, a length of stout cord, and weights. Blocks to raise the bottom of the bed are also required.

The stirrup is made of a piece of hard wood about 4 inches long by 3 wide, with a hole in the middle. A piece of webbing about 9 inches long, to either end of which small buckles are sewn, is attached (either by tacks or adhesive strapping) to the under surface of the piece of wood, and forms the sides of the stirrup; the cord is

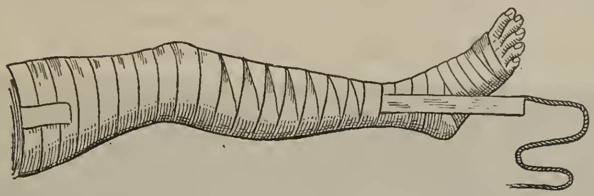


Fig. 118.—Adhesive plaster applied to make extension (DaCosta).

passed through the hole and knotted on the upper surface of the stirrups. The pulley is attached to the bed-rail, the cord carried over the pulley, and the weights attached to the cord. Iron weights, bags of shot, or toy buckets filled with shot or pebbles may be used, but should always be clearly marked with the weight, so that the amount carried can be seen at a glance.

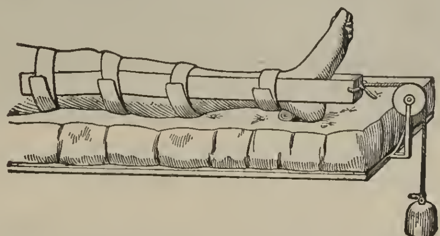


Fig. 119.—Extension apparatus. A bandage is applied over the strapping (Da Costa).

The most common use of the extension apparatus is in treatment of hip disease or of fractures or dislocation of the hip or femur. In these cases the strips of adhesive plaster 2 or 3 inches wide, cut sufficiently long to reach from the fracture or seat of disease to 3 or 4 inches beyond the foot, are applied on either side of the limb.

Before applying, the leg should be washed, and, if necessary, shaved. The strips are applied to the inner and the outer surface of the limb, stopping just above the prominent bones of the ankle (the malleoli). A snip is made at this point in either margin, and the strip of plaster folded on itself, so that the adhesive surface is covered. The strips are kept in place by two or three narrow strips of plaster applied spirally at intervals round the limb, and by a figure-of-8 bandage which should include the foot,

Fig. 120.—Fracture of the femur in a child. Note Bradford frame on which child rests. Note coaptation splints, extension, weight, and pulley (Scudder).

but leave the heel free. If the foot is not bandaged also, it is apt to become edematous. The free ends of the adhesive strips are then passed through the buckles on the stirrup and the apparatus is complete.

The foot of the bed is raised on blocks; in this position the weight of the body pulls against the weights of the extension, forming counterextension at the point at which the extension is applied. The head should be low, one flat pillow only being allowed. The pulley, as a rule,

should be at a sufficient height to prevent the heel resting on the bed. The adjustment of the pulley naturally alters the direction of the traction. The height ordered by the surgeon must be carefully maintained.

In treating fracture of the femur in young children **vertical extension** is often used. The pulley, instead of being screwed to the lower rail of the bedstead, is attached to a cross-bar or a strong frame the width of the bed, and about 3 or 4 feet higher than the height of the mattress. The cord is run through the pulley and the weights attached in the usual way. The cross-bar is in such a position that the legs, when elevated, are at right angles with the body. In the illustration the leg is short enough to be attached to an iron cradle (Saulter's, see below). Both limbs may be elevated, but the extension is applied only to the injured side. The child must be kept flat on the back and in a fixed position (see below).

The extension is also used, but more rarely, for injuries of the upper extremity involving the shoulder-joint and upper portion of the humerus, and in the treatment of injuries and disease of the knee. In all cases the extension plaster is applied immediately below the lesion, and the weight of the body is used as counterextension.

The extension applied, the position must be strictly maintained. With restless children this is frequently not possible without some method of tying the child on to his mattress.

A practical restraint is made out of wide cotton webbing. To a length of webbing the width of the chest two loops are firmly sewn, much as a child's pair of reins is made. The arms are put through the loops; a length of webbing is brought over the mattress through the arm loops, under the child's shoulders, and secured by buckles or strong safety-pins to the frame of the bedstead on either side. Such a restraint may be elaborated in several ways. Instead of the webbing a sleeveless jacket may be made of stout muslin or flannel, with the long length of the webbing passed through the arm-holes in the same way. The jacket is a better restraint if the child is mischievous.

The **Bradford frame** is an appliance in common use in

connection with extension treatment in children, either for fractures or for joint disease.

It consists of a simple frame of gas-piping about 1 foot longer than the child, and ½ foot wider than the width at the shoulders. Two pieces of canvas are stretched across the frame from side to side and stitched securely in place. The two canvases fill the frame, except exactly in the center of its length, where a space from 9 to 12 inches is left. The child is laid on the frame, with the buttocks directly over the space. A short stout roller towel is then closely pinned to the canvass on either side of the body from the axilla to below the crest of the ilium, passing over the body, and then fastening the child to the upper part of the frame. A second towel is secured in

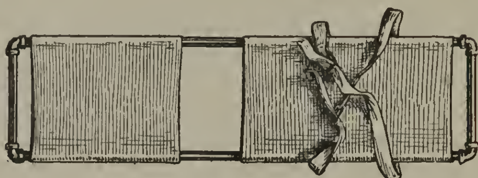


Fig. 121.—Bradford bed-frame for fixation of trunk in fracture of the thigh. In this illustration straps are used instead of the roller towel (Scudder).

the same way on either side of the sound leg, placing a heel pad above the heel to avoid pressure. To the affected limb the extension is applied.

In giving the bed-pan the frame is easily raised, and the bed-pan slipped into place without disturbing the position of the patient or danger of sudden movement to the injured part. The patient can also be taken out of bed or moved out-of-doors on the frame, the necessary position and immobility still maintained. It is one of the most simple, inexpensive, and practically efficient of appliances in children's surgical nursing.

FRACTURE BOARDS, SAND-BAGS, CRADLES

Fracture boards are boards of wood of convenient width, cut as long as the width of the bed. They are placed

below the ordinary mattress or the spring mattress, where one is used, across the frame of the bed, to prevent sagging in cases where a rigid position is necessary.

Narrow sand-bags of different lengths made of stout linen ticking are constantly used to help in maintaining fixed position. They should be provided with washable slip-covers. When a patient is restless, a towel may first be placed across the limb or other part to be fixed, and under the sand-bags, the sand-bags, placed close on either side to prevent lateral movement, will then, by holding the towel in place, also prevent upward movement.

Cradles of stout wire, iron, wood, or wicker work are used to prevent the bed-clothes resting on the patient or on tender parts. They are formed of three or more half hoops, resting on flat runners, and kept in place by cross-pieces. A couple of large cradles 2 feet long by about 18 inches high, placed over the body from the shoulders to the feet, are used in making the closed cabinet in giving vapor baths, etc. Smaller cradles are used to protect one limb or a foot, etc. Metal cradles should be wound with a bandage to prevent rust-marks on the sheets.

A special cradle, known as Saulter's cradle, is furnished with pulleys, from which is suspended a hammock made of strips of webbing attached to a wooden frame (see illustration of fractured femur in a child, Fig. 120). It is used to suspend the extended leg, at the same time flexing the thigh. A back splint swung by tapes from an ordinary cradle answers the same purpose. It is a common position for fractures of the tibia and fibula, and permits the patient more freedom of movement than when the splint is kept on the mattress with lateral sand-bags.

STRAPPING

In surgery, adhesive strapping is frequently used not only for fixing appliances or splints, but in order to apply local pressure or support.

Adhesive strapping is a solution of rubber, petrolatum, and diachylon or lead plaster (p. 111), spread on linen, and applied directly to the skin; the warmth of the body

melts the preparation sufficiently to cause it to adhere closely. Zinc oxid is also used in place of the lead in the preparation. Applied for any length of time to one spot, as, for example, in connection with a Buck's extension, adhesive plaster is apt to irritate the skin, sometimes causing an eczema difficult to cure. In such circumstances a thin gauze bandage may be first applied closely to the limb, and the adhesive plaster applied over it. This is unsatisfactory, as the weights of the extension are apt to pull the strapping out of place and frequent reapplication is necessary. In some children's hospitals a closely fitting stocking of Canton flannel laced up the front is used, over which the extension straps are applied. No traction is, however, quite so good as when the strapping is applied directly on the skin. The removal of strapping is painful, owing to the wrenching of small hairs which have become adherent to the plaster. To lessen this the part may be shaved before the plaster is applied. In removing, the plaster should be dabbed with a sponge soaked in turpentine or ether, either of which will partially dissolve the plaster and make the removal less painful. Adhesive plaster is applied in strips. As it forms an inelastic application, it will cause constriction if applied straight round a limb or entirely encircling the body. The strips should be applied obliquely. Where intended for support or to apply pressure, two sets of strips are applied, each strip beginning at opposite points, crossing the opposite strip obliquely and overlapping the lower strip one-third of its width.

Fracture of the Ribs.—In the treatment of fracture of the ribs an application of adhesive plaster is frequently ordered to act as a splint and prevent movement of the broken ends of the bone. For this purpose the strips of strapping are cut 2 inches wide, and sufficiently long to cover one side of the chest from a point beyond the backbone behind to a point beyond the sternum in front, extending from the waist to the axilla. Where possible, the patient should stand to have the plaster applied, with the arms hanging straight from the shoulder. He should take a long breath and "empty" his lungs, keeping them

so while the plaster is applied. In a male patient the chest is shaved, in a female patient the breast is not covered.

Beginning below the axilla, the strips are passed obliquely from back to front and front to back alternately, crossing each other, each strip overlapping the one below one-third of its width. The application is finished by a straight strip. Strapping applied in this way is also frequently used in pleurisy, where it relieves pain and to some extent checks the formation of fluid.

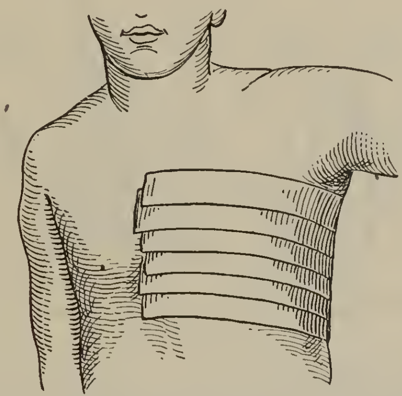


Fig. 122.—Strapping the ribs (after A. S. Morrow).

A **fractured clavicle** (p. 619) is also frequently treated with adhesive strapping. The method is known as *Sayre's dressing*. Two long pieces of strapping are required 3 inches wide. A pad is placed in the axilla of the affected side, and a piece of gauze in the bend of the elbow. The hand is brought over the chest, and made to grasp the opposite shoulder. One strip of adhesive strapping is secured firmly round the upper arm of the affected side, opposite the axilla, and passing over the outer surface of the arm across the back and under the opposite axilla, is brought across the chest under the flexed arm and finished below the starting-point.

The second strip starts at the opposite shoulder, crosses the back obliquely, passes over the point of the elbow on

the affected side, and up along the dorsal surface of the forearm and hand over the sound shoulder, and finishes at a point above half-way across the back, sufficient to give a firm hold. A small hole cut where the point of the elbow rests makes the plaster fit more closely. With this appliance the shoulder is forced upward, backward, and outward, and the joint is held in a fixed position. The whole may be further secured by a wide roller bandage round the chest and flexed arm.

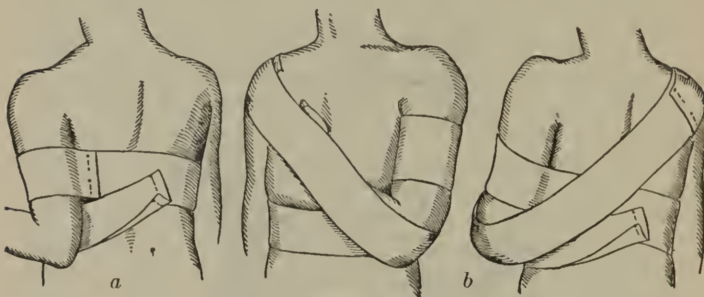


Fig. 123.—Sayre's dressing: *a*, First strip; *b*, second strip, front and back views (Beck).

Chronic ulcers of the leg are frequently treated successfully by strapping; the application is made in the same way as in strapping the chest, the strips crossing each other obliquely and not entirely encircling the limb. The strips should be about ½ inch wide. For appearance sake the ends should be cut even and covered by a straight strip at either side. The leg should be kept elevated, and the plaster renewed every four or six days.

Sprains.—Strapping is also used as a local support and to apply pressure in the treatment of sprains. They are usually applied in a modified figure-of-8, care being taken not completely to encircle the joint with any one strip. The strips are cut about 1 inch wide, and sufficiently long to be carried obliquely around the limb, cross in front, and continue half round the limb again. If a straight strip is used to finish it, the ends should not meet.

To Strap an Ankle.—To strap an ankle two sets of adhesive strips are used. The first set is applied like a stirrup, below the heel, and up either side of the ankle to a point beyond the swelling. The second set is applied over the first from the back of the ankle toward the instep, each strip crossing the one below at right angles.

Fig. 124.—Strapping an ankle-joint (after A. S. Morrow).

Strapping Wounds.—Where strapping is used in place of stitches to bring the edges of wounds together, the strips should be cut sufficiently long to grip firmly the tissues on either side. The strips are attached on either side and brought across to the opposite side alternately, crossing over the wound, which should not be completely covered.

An abdominal dressing is sometimes kept in place by broad strips of strapping to which tapes are firmly sewn. Three strips are applied to either flank, and the tapes tied together over the dressing. At first a Scultetus bandage is applied over the strips, but if there is no oozing, this is discarded after the second day, usually to the relief of the patient.

KNOTS

The Granny Knot.—This is the tie knot in domestic use. It has the disadvantage of readily slipping if subjected to

strain. In surgical work the granny knot is replaced by the reef knot and the surgeon's knot.

Reef Knot.—The first twist of a reef knot is the same as the granny knot. In a granny knot the second twist is made by bringing the free end lying behind forward, and crossing it over the other in front; in a reef knot for the

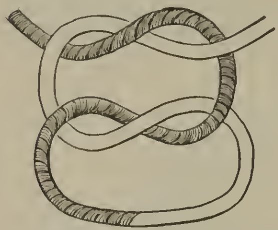


Fig. 125.—Method of tying granny knot (DaCosta).

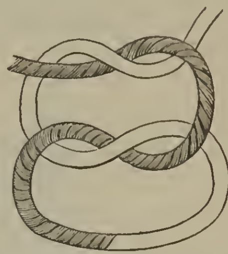


Fig. 126.—Method of tying square or reef knot (DaCosta).

second twist the free end lying in front is held in front, and passed from the front backward over the end lying behind and coming out through the loop. In this way the free ends of the loop are parallel to the loop, whereas in a granny knot they lie at right angles. The loops of a reef knot will not slip, however great the strain, provided the ends forming the knot are of the same thickness.

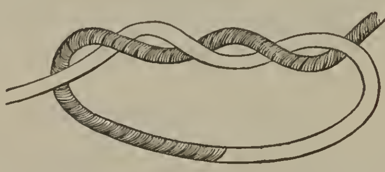


Fig. 127.—Method of tying surgeon's knot (DaCosta).

In the **surgeon's knot** the ends are crossed and each twisted once—the right to the left and the left to the right of the point at which they cross. It is used in many circumstances, such as ligation, strangulation, etc. Very commonly a combination of reef and surgical knot is used, especially in sutures.

Clove-hitch.—A clove-hitch forms a double loop, which is pulled tight by traction on the free ends. There are a variety of ways of holding and twisting the cord or bandage to form the hitch; the following is as simple as any:

1. Hold the cord at a convenient interval between finger and thumb of either hand, the hands lying palms upward, the free ends of the cord hanging from the thumb side.

2. Holding the cord firmly, turn the hands knuckles upward, bringing the thumbs opposite each other. The free ends are then hanging on the further side of the cord from the operator.

3. With one movement pass the free end on the right hand over the cord toward the operator: the ends are then on either side of the cord.

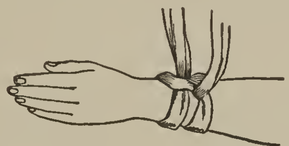


Fig. 128.—Clove-hitch knot applied (Erichsen).

4. Without moving the ends or twisting either of the loops, pass the loop from the left hand on to the fingers of the right and the hitch is made. The position of the hands must not be changed in this movement, the knuckles of the left hand must stay uppermost, with the thumb toward the operator; the usual mistake is to turn the left hand. When complete, each free end forms a loop, one in front and one behind the central cord, and crosses the other over the central cord.

Where there is much awkwardness in learning the knots, a red and white tape knotted together used to demonstrate, generally makes them more readily understood.

CHAPTER IX

MEDICINES

Weights and Measures—The Metric System—Names of Preparations—Terms in Common Use—Dosage—Time of Administration—Average Dose of Commonly Used Medicines—Table of Abbreviations—Table of Familiar Preparations—Methods of Administration.

The chief duties of a nurse in administering medicines are to measure accurately, to give punctually, and to observe the effects. To accomplish the first she must understand the measures in common use; for the latter she must have a sound, however elementary, knowledge of the physiologic action of the drugs employed. Wherever possible, teaching on this important subject should be given at an early date in the pupil's training. As, however, the observation of the effects of a drug is never left exclusively to pupil nurses, it is reasonable and practical to permit a young nurse to administer medicines once she understands how to measure them, and her sense of responsibility and her accuracy have been adequately tested. A pupil should not be put in any position of higher responsibility, such as a senior nurse in a ward, before she has a working knowledge of the effects of the drugs the use of which she will be expected to supervise.

WEIGHTS AND MEASURES

For the weighing and measuring of drugs two systems are in use, the apothecaries and the metric. The apothecaries is still in general use in America and in Great Britain, though the use of the metric system is gradually gaining ground.

Apothecary measures are as follows:

Apothecaries' Weight.

20 grains	=	1 scruple.
3 scruples, or 60 grains	=	1 dram or drachm.
8 drams	=	1 ounce.
12 ounces	=	1 pound.

Apothecaries' Fluid or Wine Measure.

60 minims	=	1 fluidram or fluidrachm.
8 fluidrams	=	1 fluidounce.
16 fluidounces	=	1 pint.
8 pints	=	1 gallon.

To express these measures, signs are employed as follows:

Scruple	℈	
Dram........	ʒ	
Ounce	℥	
Pound.......	℔,	an abbreviation of the Latin *libra*.
Minim.......	♏	
Pint.........	O,	abbreviation of Latin *octarius*, a pint being the eighth part of a gallon.
Gallon.......	C,	abbreviation of Latin *congius*.

When the sign is used, the numeral denoting the quantity follows the sign, Latin numerals being invariably used: thus, Oij, or 2 pints; ℥j, or 1 ounce. When half the quantity expressed by a sign is to be signified, the Latin word for half, *semis*, abbreviated to *ss*, is commonly used. For example, 30 minims is equivalent to half a dram; it may be written equally correctly as ♏xxx or as ʒss. Should the half be used with a whole number, the *ss* is placed directly after the numeral, without the repetition of the sign thus—ʒiss, ℥iiss, Oiss.

The scruple is little used in measuring medicines, the fractional parts of a dram usually being expressed in minims where fluids, and grains where solids, are understood.

Avoirdupois.—Some confusion is occasionally met with in regard to terms which are the same in apothecaries' measures and in others. The common blunders are between the pound avoirdupois and the pound apothecary, and between the *imperial* pint and the pint of the *American* apothecaries' measure.

Avoirdupois Weight.

27.34 grains	=	1 dram.
16 drams	=	1 ounce.
16 ounces	=	1 pound,

whereas the apothecaries' measure employs the troy table, in which 12 ounces make one pound.

Avoirdupois is not used in measuring drugs, but may be met with by the nurse in weighing bulk, such as tumors, newborn infants, etc. Where the avoirdupois scale is used, the word avoirdupois should be written after the weight.

The pint of the standard liquid measure contains 20 fluidounces, each ounce being equal to 8 fluidrams. This pint is derived from a *fixed measure of weight*, the gallon, of which the pint is an eighth part, being equivalent to 10 pounds of water at its greatest density (4° C.). In America the apothecaries' measure has for convenience adopted 16 ounces as the equivalent of the fluid pint, the same number of ounces as in the pound avoirdupois. Where the standard pint is intended, it is distinguished as the *Imperial pint*. In other countries the standard pint of 20 ounces is used, which may cause confusion if the difference is not understood.

The Drop.—It must be remembered that the *minim* is an official drop of a fixed standard, whereas the natural drop formed by liquids varies in bulk with the density of the liquid. Where the natural drop is intended the word gutta (gtt.) is used instead of minim. Approximately in measuring water or aquecus fluids a drop is equal to a minim; for alcohol solutions, such as tinctures, two drops form the minim; while volatile drugs, such as ether or chloroform, count about 4 drops to the minim. On the other hand, a drop of a gummy or syrupy substance is larger than a minim.

Tables giving the exact number of drops to a minim of any drug will be found in most text-books on materia medica.

Where the sign minim is used with an order, the drug must invariably be measured in a minim glass; at the same time it is inaccurate to use a minim measure if *gutta* are ordered. Drops, or gutta, are best measured with a pipet fitted with a rubber cap or nipple, by compressing which gently the liquid is forced out in drops of equal size.

Where lesser quantities than the grain or minim are required, the amount is expressed in fractions. Thus

we may have half a minim, an eighth of a grain, and so forth.

Fractional Doses.—A little practice is often necessary to teach pupils to reckon accurately the total amount taken of a drug given in fractional doses. Where each dose is of equal value, the denominator is multiplied by the number of doses: thus, $\frac{1}{16}$ repeated four times equals $\frac{4}{16}$ or $\frac{1}{4}$. Where the fractions are of mixed values, the common denominator must first be sought, each numerator multiplied by the number of times its denominator is contained in the common denominator, and the results, added together, placed over the common denominator.

Thus, to add $\frac{1}{60} + \frac{1}{30} + \frac{1}{15}$. The common denominator being 60, the sum stands

$$\frac{1 + 2 + 4}{60} = \frac{7}{60}.$$

Practice should also be given in preparing fractional doses from preparations of a different fractional value. Thus, a dose of $\frac{1}{80}$ may be ordered where the stock solution is made up in the strength of $\frac{1}{100}$ in every so many minims, usually 10 or 12. To find the required dose the strength of the stock solution is multiplied by the number of minims in which it is contained, and the result is divided by the strength of the dose required. For example, suppose a stock solution to contain $\frac{1}{100}$ grain in every 10 minims and we wish to give a dose of $\frac{1}{80}$ of a grain, the sum is worked as follows:

$$100 \times 10 = 1000 : 1000 \div 80 = 12\tfrac{1}{2}.$$

Twelve and a half minims will contain $\frac{1}{80}$ grain of the drug. Where drugs are put up in tablet form, the same method may be carried out, the tablet first being dissolved in a given number of minims.

Measuring-glasses.—In administering medicines graduated measures are used, on which the measurements correspond exactly to the apothecaries' fluid measure. The use of spoons or cups in place of the graduated measure tends to inaccuracy, and should not be permitted. Approx-

imately, apothecaries' measure corresponds to domestic measures as follows:

1 teaspoon	=	1 dram.
1 dessertspoon	=	2 drams.
1 tablespoon	=	½ ounce.
1 wineglass	=	2 ounces.
1 cupful	=	4 to 5 ounces.
1 tumblerful	=	8 to 10 ounces.

THE METRIC SYSTEM

The metric system of measuring originated in France about the end of the eighteenth century, and is at present the only one in use on the continent of Europe. It is universally used in scientific work, and is coming more and more into general use in medicine in America. In the medical department of the United States Army it is used entirely in place of the apothecaries' weights and measures.

The metric system is a decimal system, like the decimal system of coinage, of which the American symbols are the dollar, dime, and cent. The fractions, that is to say, are all tenth, hundredth, or thousandth parts of the unit, which is represented in the United States coinage by the dollar.

To illustrate simply this essential difference between the fraction in ordinary use and those of the decimal or metric system, take the sum of a dollar and twenty-five cents. By ordinary reckoning the so-called vulgar fractions, we may describe the sum as one dollar and a quarter, twenty-five cents being ¼ the value of the unit or dollar. By decimal fractions the same sum is expressed as one dollar twenty-five cents ($1.25), that is one dollar, two-tenths, and five-hundredths of a dollar, or, more simply, twenty-five hundredths of a dollar.

The advantages of the metric system are in the greater facility it presents for calculating, especially in multiplying and dividing, and that it makes possible a common scale for measures of length, weight, and volume.

The Measure of Length.—The parent measure on which the others are based is the measure of length. To obtain this the polar circumference of the earth is taken as a

fixed measure, and the ten-millionth part of one-quarter of the circumference is taken as the unit. This measure is called the *meter*, from the Greek *metron*, a measure. It measures a little over 39 inches. Following the decimal system, the meter is subdivided into tens, hundreds, and thousands, instead of, as in the yard, into feet and inches. These divisions are named by placing, before the word meter, the Latin prefixes deci- (10), centi- (100), milli- (1000). As in coinage, the *fraction* is expressed by a point placed after the unit and before the fraction, and the *value* of the fraction by its place after the point. Thus, tenths are expressed as 0.1; hundredths, as 0.01; and thousandths as 0.001. For example, 0.257 of a meter represents $\frac{2}{10} + \frac{5}{100} + \frac{7}{1000}$, or 2 decimeters, 5 centimeters, and 7 millimeters; or, more simply, 257 millimeters.

The measure most constantly met with is the *centimeter*, which takes the place of the inch in the yard measure, and measures, approximately, $\frac{3}{8}$ inch. For the multiplication of the meter the Greek prefixes deka- (10), hekto- (100), and kilo- (1000) are placed before the word meter. A kilometer thus is a measure of 1000 meters.

The divisions of the meter most frequently used compare approximately with ordinary lineal measure, as follows:

1 millimeter	=	$\frac{1}{25}$ inch.
1 centimeter	=	$\frac{3}{8}$ inch.
1 decimeter	=	4 inches.
1 meter	=	39.37 inches.
1 kilometer	=	3280 feet 7 inches, or about $\frac{5}{8}$ mile.

The same prefixes, deci-, centi-, and milli-, for the divisions, and deka-, hekto-, and kilo-, for the multiplications, are used before the unit in the measures of weight, capacity, and volume, based on the meter.

The **measure of capacity** is derived from the *cube* of the meter. A cube is a body measuring exactly the same in its three dimensions of length, breadth, and height. For example, while the term 1 meter signifies a line 1 meter in length, 1 cubic meter represents a body, or a space, which measures 1 meter in length, breadth, and height.

Where the cube is intended, the word cubic is placed before the prefixes of multiplication or division; thus, cubic millimeter, cubic centimeter, etc.

The Measure of Volume.—The name *liter* is given to the unit of the measure of volume; it corresponds approximately to the quart, or two pints. The liter represents the capacity of a cube measuring 1 decimeter (one-tenth of a meter) in each of its three dimensions, that is, *one cubic decimeter* (approximately, 4 cubic inches), by which term it might equally well have been known. Using the same prefixes that are used in the multiplication and divisions of the meter, we have the deciliter, centiliter, and milliliter, the dekaliter, hectoliter, and kiloliter.

The measure of capacity is equally the measure of volume, and is used in measuring fluids, the liter representing the volume of water required to fill a cube of that capacity. For these measurements water is taken at its greatest density, which is 4° C. From its size, however, the liter is an inconvenient standard where small amounts and their fractions have to be reckoned. It would obviously be impractical to describe the minim or the dram as fractional parts of a quart. To overcome this disadvantage, in place of the subdivisions of the liter we use the cube of the centimeter, which is equal to one milliliter. This represents the volume of water at 4° C. required to fill a cube measuring 1 centimeter ($\frac{2}{5}$ inch) in each of its three dimensions. This measure is the ordinary medicinal unit, and is used entirely in place of the subdivisions of the liter. Thus, instead of one deciliter, we say 100 cubic centimeters. A liter also is frequently described as 1000 cubic centimeters.

The apothecaries' fluid measures are expressed in cubic centimeters, as follows:

		Approximately.	*Accurately.*
1 minim	=	. . . .	0.06 c.c.
15 minims	=	1 c c.	0.92 c.c.
1 fluidram	=	4 c.c.	3.75 c.c.
1 fluidounce	=	30 c.c.	29.57 c.c.
1 pint	=	500 c.c.	473.11 c.c.
1 quart	=	1000 c.c. or 1 liter	950.22 c.c.

Metric Weights.—The unit of weight is the weight of one cubic centimeter of water at its greatest density (4° C.). To this unit the name *gram* has been given. Thus, one cubic centimeter of water by measure equals one gram of water by weight.

The multiplications and divisions of the gram are also expressed by the prefixes mentioned above, *i. e.*, the decigram, centigram, and milligram, the dekagram, hektogram, and kilogram.

The metric measure of weight corresponds to the other measures of weight as follows:

Apothecaries' Measure.

		Approximately.	*Accurately.*
1 grain	=	65 milligrams	0.065 gm.
15 grains	=	1 gram	0.972 gm.
1 dram	=	4 grams	3.900 gm.
4 drams or ½ an ounce	=	15 grams	15.500 gm.
1 ounce	=	30 grams	31.100 gm.
12 ounces or 1 pound	=	400 grams	373.230 gm.

Avoirdupois.

1 ounce	=	30 grams	28.35 gm.
1 pound	=	450 grams	453.60 gm.
2 pounds 2 ounces	=	....	1000.00 gm. or 1 kilogram.

Arabic numerals are used instead of the Latin ones, and the measure, represented either by its initial letter or an abbreviation, is placed after the number: thus, 15 gm., 200 c.c.; in writing prescriptions the former is usually omitted, gm. being understood. Thus, a dose of a drug may be written simply 0.65, signifying 0.65 gram.

The Common Metric Measures.—The measures of the metric system in most common use and their signs are as follows:

The meter	M.
Centimeter	cm.
Millimeter........................	mm.
Cubic centimeter..................	c.c.
Liter	L.
Gram	gm.
Kilogram........................	K.

Approximate Values of Metric Measures.—As a rough estimate in measuring and weighing drugs the following

approximate values of the measures in most common use are generally accepted:

500 c.c.	for	1 pint (American).
500 gm.	for	1 pound (avoirdupois).
30 c.c.	for	1 fluidounce.
30 gm.	for	1 ounce by weight.
4 c.c.	for	1 fluidram.
4 gm.	for	1 dram by weight.
1 c.c.	for	15 minims.
1 gm.	for	15 grains.

Changing Apothecaries' to Metric.—Frequently it may be of use to express a dose measured by apothecaries' measure by the metric system. To do so, the simplest method is to reduce the dose to minims or grains and divide by 15, the approximate number of minims or grains in the cubic centimeter or gram respectively. If the bulk is large, it may, instead, be reckoned in drams and divided by 4, the number of cubic centimeters or grams in a dram.

To express portions of a grain in grams two methods can be used. It will be remembered that the grain is equal to 0.065 gm., or 65 milligrams. Half a grain, therefore, represents 33 milligrams (0.033 gm.); $\frac{1}{4}$ grain, 16 milligrams (0.016); $\frac{1}{3}$, 20 milligrams (0.02), and so forth.

A second and more convenient working method is to express the fraction as a decimal, and, as in other doses, to divide by 15. For example, $\frac{3}{8}$ expressed in decimal fractions is 0.37, which, divided by 15, is 0.025. A dose of $\frac{3}{8}$ grain is, therefore, represented by the metric system as 0.025 gram, or 25 milligrams.

In some tables, comparing doses by vulgar fractions with fractional doses by metric measure, the calculation is made with $15\frac{1}{2}$ instead of with 15. The difference of the dose is so extremely small that the more convenient 15 is generally allowed as sufficiently accurate.

NAMES OF PREPARATIONS

The tables and measures having been mastered, the different forms in which drugs are made up should next be studied. The actual preparation should be used, with which the pupils should be made familiar by observation, smell, and, where practical, taste. At the same time

a simple general classification of the drugs used into the animal, vegetable, or mineral kingdoms can be made:

LATIN.	ENGLISH.	DESCRIPTION.	EXAMPLE.
Abstractum (Abstr.).	Abstract.	A powdered extract mixed with sugar of milk. It is twice the strength of a fluidextract.	
Acetum.	Vinegar.	The medicinal substance of a drug dissolved in vinegar or acetic acid.	Acetate of lead.
Aqua (Aq.).	Water.	A volatile substance dissolved in water.	Ammonia water.
Ceratum.	Cerate.	A species of ointment made up with wax, in order that the application should not melt at the temperature of the body.	Cerate of zinc, the acetate of lead.
Confectio (Conf.).	Confection.	A medicinal substance compounded with honey or syrup.	Confection of senna.
Decoctum (Decoc.).	Decoction.	The strained water in which a vegetable drug has been boiled.	Decoc. of digitalis leaves (not official).
Elixir (Elix.).	Elixir.	An alcoholic solution, sweetened and spiced.	Elixir iron, quinin, and strychnin.
Emplastrum (Emplas.).	Plaster.	Medicinal substances spread on a suitable material for external application.	Belladonna plasters.
Emulsum.	Emulsion.	A solution in which an oily substance is suspended in water.	Cod-liver-oil emulsion.
Extractum (Ext.).	Solid extract.	An evaporated fluidextract.	Ext. of belladonna.
Fluid extractum (Fl. ex.).	Fluidextract.	The active principle of a drug dissolved in alcohol, so that 1 minim of the extract is equivalent to 1 grain of the drug.	Fluidextract of cascara.
Glyceritum (Glyc.).	Glycerite.	A solution of a drug in glycerin.	Glycerite of tannic acid.
Infusum (Infus.).	Infusion.	Obtained by pouring water on a drug and steeping it. Boiling water is used, except for volatile drugs, for which cold water is used; the strength is usually 5 per cent.	Infusion of digitalis.

Latin.	English.	Description.	Example.
Linimentum (Lin.).	Liniment.	A solution of a drug (usually anodyne or counterirritant) in oil or alcohol to a soapy consistence. Applied externally with friction.	Belladonna liniment.
Liquor.	Solution.	A non-volatile drug dissolved in water.	Liquor arsenicalis.
Mistura (Mist.).	Mixture.	An insoluble substance, finely divided and held suspended in water by the aid of a viscid substance, such as gum.	Chalk mixture.
Mucilago (Muc.).	Mucilage.	Solution of a gum in water.	Mucilage of tragacanth.
Oleatum (Ol.).	Oleate.	A drug dissolved in oleic acid.	Oleate of mercury.
Pilula (Pil.).	Pill.	A drug rolled into a small round mass, which can be dissolved in the stomach.	Blaud's pill.
Pulvis (Pulv.).	Powder.	A solid drug finely powdered.	Powdered opium.
Spiritus (Sp.).	Spirits.	A volatile drug dissolved in alcohol.	Sweet spirits of niter.
Suppositorium.	Suppository.	A preparation of a drug in cocoa-butter, in suitable shape for insertion in the rectum, vagina, or urethra.	Opium suppository.
Syrupus (Syr.).	Syrup.	A concentrated solution of sugar and water. A drug suspended in simple syrup.	Syrup of squills.
Tabella (Tab.).	Tablet or tabloid.	A very small tablet of sugar of milk, with which a drug is incorporated.	
Tinctura (Tinct.).	Tincture.	A solution of a non-volatile drug in alcohol.	Tincture of opium.
Trituratio (Trit.).	Triturate.	A powdered preparation containing 10 per cent. of a drug in sugar of milk.	
Trochiscus (Troch.).	Lozenge.	A lozenge containing a drug.	Troche of tannic acid.
Unguentum (Ung.).	Ointment.	A semisolid preparation of a drug in fat or oil.	Zinc ointment.
Vinum (Vin.).	Wine.	A drug dissolved in sherry.	Wine of ipecac.

Drugs in either powdered or fluid form are also put up in minute gelatin boxes or *capsules*, which melt at the temperature of the stomach.

Other terms frequently met with in medicine which it is necessary to understand are as follows:

Element.—That which cannot be divided or reduced to a simpler form. *Ex.:* oxygen, iron, carbon, etc.

Chemical Compound.—The union of two or more elements to form a new substance, in which the elements completely lose their identity. *Ex.:* hydrogen and oxygen combined form water.

Base.—The fundamental element of a mixture.

Acids.—The chemical compounds of hydrogen are known as acids, it is supposed, on account of their sharp taste.

Salts.—The union of an acid with a base is known in chemistry as a *salt.* *Ex.:* morphin sulphate.

Alkaloid.—The active principle of a drug. *Ex.:* morphine, of opium; atropin, of belladonna. The alkaloids unite with acids to form salts, in which condition they are soluble in water. *Ex.:* morphin sulphate.

Alkali.—A caustic base having certain properties; it saponifies fat, turns litmus-paper blue, is soluble in water, and unites with acids to form salts. The alkali metals are potassium, lithium, sodium, and ammonium.

A large variety of names are used to describe the physiologic effect of a drug. The following are a few of the most important:

Analgesic.—A drug taken internally to relieve pain.

Anesthetic.—A drug causing local insensibility, or, taken internally, general unconsciousness.

Anodyne.—A drug applied locally to relieve pain.

Anthelmintic (*Teniacide*).—A drug that expels worms.

Antihydrotic.—A drug which diminishes sweat.

Antipyretic.—A drug that reduces fever.

Aperient.—A drug that opens the bowels.

Astringent.—A drug causing contraction of organic tissue, thereby lessening secretions.

Carminative.—A drug that disperses gas in the stomach or intestines.

Cathartic (*Purgative*).—A powerful aperient.

Cholagogue.—A drug which increases the secretion of bile.

Diaphoretic (*Sudorific*).—A drug which increases the secretion of sweat.

Diuretic.—A drug which increases the secretion of urine.

Ecbolic (*Oxytocic*).—A drug which stimulates the contractions of the uterus.

Emetic.—A drug which causes vomiting.

Emmenagogue.—A drug which stimulates menstruation.

Epispastic (*Vesicant*).—A drug which, applied locally, produces a blister.

Expectorant.—A drug which stimulates the secretion of the organs of respiration.

Galactagogue.—A drug which increases the secretion of milk.

Hemostatic.—A drug which causes the arrest of hemorrhage.

Hydragogue.—A drug which produces watery evacuations.

Hypnotic (*Narcotic; Soporific; Somnifacient*).—A drug which produces sleep.

Mydriatic.—A drug which dilates the pupil.

Myotic.—A drug which contracts the pupil.

Sedative.—A drug which quiets the nervous system without actually producing sleep.

Sialagogue (*Ptyalagogue*).—A drug which increases the secretion of saliva.

DOSAGE

The dosage of a drug is modified to some extent by *age*, *sex*, *individuality*, *idiosyncrasy*, and *race*.

Age.—Children and old people require proportionately less of a drug than adults. No fixed rule for determining the dose for a child according to its age is invariably reliable; the following, known as Young's rule, is, however, frequently used:

To the years of age add *twelve*, divide the sum by the age, and take the result as the proportion of the adult dose.

Example: For a child six years old:

$$6 + 12 = \frac{18}{6} = 3. \text{ The dose is } \frac{1}{3} \text{ that for an adult.}$$

Some drugs, such as opium, however, act on a child relatively more powerfully than on an adult. For such drugs half the dose estimated by Young's rule is usually the maximum considered safe. For laxatives, on the other hand, a larger proportion—from $\frac{1}{3}$ to $\frac{1}{2}$ more than by Young's rule—is usually necessary.

Sex.—Speaking generally, men tolerate larger doses of drugs than women.

Individuality.—Some individuals are peculiarly susceptible to drugs, and require, therefore, doses smaller than the average.

Idiosyncrasy.—Persons are met with who become quickly poisoned by certain foods, taken by the majority with impunity; some, for example, are poisoned by the smallest portion of mushroom. The same idiosyncrasy is also sometimes displayed toward drugs, and, if not previously known, may lead to accidents. Some have an intolerance for opium, a small dose producing toxic symptoms. For this reason, if a nurse, in a serious emergency, is left to her own resources and obliged to use a powerful drug, she should be extremely careful to give the smallest dose possible, until she has observed the physiologic effect.

Race.—Race influences dosage to a certain extent. The colored races, for example, tolerate larger doses of many medicines than the white race.

The **action** of a drug may also be modified by many circumstances, such as fasting, pain, the physical condition of the patient, the time at which the drug is given, the method by which it is given, the accumulative property of a special drug, or tolerance established by the use of a drug.

A drug taken fasting will act more quickly and more powerfully than if taken on a full stomach. For example, a dose of alcohol which will intoxicate if taken fasting, is tolerated if taken with a meal.

Where pain is acute, proportionately larger doses of a narcotic or anodyne may be required to produce results usually obtained by a smaller dose. Similarly, in conditions of shock or collapse abnormally large doses of stimulants are tolerated. A drug intended as an antidote is also given in doses larger than normal.

By **toleration** is understood the tendency of the system to become habituated to the action of a drug when administered over lengthy periods, so that to some extent it loses its effect and increased doses are necessary to obtain results. Narcotics, sedatives, anodynes, all produce toleration.

The action of volatile drugs, as, for example, *ammonia* and the *nitrites*, is prompt, and the effect passes quickly. Such drugs must be given more frequently than drugs that act slowly and produce more persistent effects. Drugs that are slowly absorbed and eliminated are given at greater intervals, otherwise, though the individual dose may be small, too much of the drug may be present at one time in the system and produce symptoms of overdose. *Digitalis* is an example of such a drug.

Certain drugs have also a tendency to accumulate in the system, and may in time produce symptoms of intolerance or even of poisoning. In giving drugs to patients with dropsy, nurses must be especially on the watch for symptoms of overdosing. The reason is that some of the drug is apt to stay suspended in the excess of fluid; as the dropsy subsides, the drug is liberated and absorbed by the system, sometimes in poisonous quantities.

Time Required for Effect.—The time necessary for a drug to produce its effect varies with the individual drug and with the method of administration. The most rapid method is, generally speaking, hypodermic injection, and the slowest, inunction. Rectal absorption is slower than absorption from the stomach, and either vary with the form of the preparation. A fluid preparation of a drug is more quickly absorbed than a solid preparation, such as a powder, pill, or tablet. The effects of inhalation are rapid, but vary again with the drug employed. Thus, for example, the inhalation of nitrite of

amyl produces results in less than one minute, while for ether or chloroform a considerably longer time is required.

In giving a drug by the stomach a time must be chosen to fit the cause for which the drug is given.

TIME OF ADMINISTRATION OF DRUGS

As a general rule, the best time for administering a drug is between meals, when the stomach is at rest. There are, however, several exceptions to this rule.

Stomachics, which are given to improve the tone of the stomach and to increase the appetite by stimulating the secretion of the gastric juice, should be given ten or fifteen minutes before a meal. Such are bitters, the dilute acids or alkaline tonics, and nux vomica.

Digestives, on the other hand, are given from fifteen minutes to half an hour after food. Their function is to supply a deficiency of one of the natural secretions during digestion, to counteract overacidity, or to correct alkalinity. The dilute acids and the alkaline tonics are also used as digestives, and the official preparations of pepsin, lactic acid, pancreatin, and others. Pancreatin, being an *intestinal* digestive fluid, is given toward the end of gastric digestion, the time varying with the kind of meal taken.

Alcohol, in moderate doses, increases the appetite if taken shortly before meals, and is of some value as a digestive if taken with a meal.

A drug that is to act *locally on the stomach* is given when the stomach is most at rest—about an hour before nourishment. Nitrate of silver, for the treatment of gastric ulcer, is given in this way.

Narcotics are given at the hour of sleep if acting quickly (*Ex.:* morphin). The nurse must be careful that everything that is to be done for or about the patient is finished before the dose is given, so that nothing may interfere with the desired effect. Many narcotics, however, in general use take some hours to act, and must, therefore, be given a corresponding length of time before the hour of sleep (*Ex.:* sulphonal, trional).

Laxatives and **cathartics** act most quickly if the stomach is empty, and are, therefore, best given in the early morning, before food is taken. For convenience, they are frequently given at bedtime.

Drugs which have an **irritating** effect on the tissues are best taken on a full stomach, not more than half an hour after meals. Such are iron, arsenic, mercury, and the iodid preparations. For the same reason, if bromid is to be taken over a length of time, it should be given after meals.

General tonics with nourishing properties, such as *cod-liver oil, malt extracts,* etc., are also best borne after meals.

RELATIVE VALUES OF DIFFERENT FORMS OF PREPARATIONS

Pupils should be taught to recognize the relative values of the different forms in which drugs are made up into medicines. The value depends on the percentage of the drug which a given quantity of the preparation represents. Thus one dram of an infusion presents a very much smaller percentage of a drug than one dram of the tincture of the same drug. Pupils should also be familiar with the average dose of the preparations they will be required to handle.

Tinctures.—*Average strength,* 10 to 15 per cent., except aconite, 35 per cent., and nux vomica, 2 per cent. *Average dose,* 5 to 20 minims. *Exceptions:* Tinctures of aconite, iodin, veratrum viride, each, 1 to 3 minims.

Infusions.—*Average dose,* 4 drams to 1 ounce. *Exception:* Infusion of digitalis, 1 to 4 drams.

Spirits.—*Average dose,* 30 minims to 1 dram. *Exceptions:* Spirit of glonoin, 1 to 3 minims, and spirit of phosphorus, camphor, and turpentine, 3 to 10 minims.

Aquæ.—*Average dose,* 4 drams to 1 ounce. *Exception:* Aqua ammonia, 5 to 20 minims, well diluted. It is not usually ordered internally.

Syrups.—*Average dose,* 1 to 2 drams. *Exception:* Syrup of iodid of iron, 10 to 30 minims.

Fluidextracts.—*Average dose,* 10 to 30 minims. *Exception:* Fluidextract of cascara sagrada, $\frac{1}{2}$ to 1 dram.

Fluidextracts of powerful drugs are given in doses of 1 to 2 minims; they are not found in the ward medicine chest. Solid extracts also ($\frac{1}{4}$ to 1 gr.) are measured in the dispensary, and usually combined with other drugs in pill form.

Mixtures.—*Average dose,* 1 to 4 drams. *Exception:* Mixture of asafetida, $\frac{1}{2}$ to 1 ounce.

Dilute Acids (strength, 10 per cent.).—*Average dose,* 10 to 30 minims. *Exception:* Dilute hydrocyanic acid (prussic acid, strength, 2 per cent.), 1 to 3 minims.[1]

ABBREVIATIONS

In ordering medicines and other remedies, many abbreviations are used, with which nurses must be familiar.

The following are the most common:

Abbreviation.	*Latin.*	*English.*
āā	ana	of each (*i. e.*, equal parts).
A. C.	ante cibum	before food.
Add.	adde	add to.
Add. part. dol.	adde partem dolente	to the painful spot.
Ad lib.	ad libitum	according to pleasure.
Alt. die.	alternis diebus	alternate days.
Alt. hor.	alternis horis	alternate hours.
Alt. noct.	alternis noctes	alternate nights.
Aq.	aqua	water.
Aq. dest.	aqua destillata	distilled water.
B. i. d.	bis in die	twice a day.
C.	cum	with.
Cap.	capiat	let him take.
Cochl.	cochleare	spoonful.
Cochl. mag.	cochleare magnum	tablespoon.
Cochl med.	cochleare medium	dessertspoon.
Cochl. parv.	cochleare parvum	teaspoon.
Collyr.	collyrium	eye-wash.
Comp.	compositum	compound.
Conf.	confectio	confection.
Contin.	continuatur	let it be continued.
Coq.	coque	boil.
Cras mane	cras mane	to-morrow morning.
Cras nocte	cras nocte	to-morrow night.
Cyath.	cyathus	a glassful
D. D.	detur ad	let it be given to.
Dil.	dilutus	diluted.
Dim.	dimidius	one-half.
D. in p. æq.	dividatur in partes æquales	divide in equal parts.
Div.	dividatus	divide.

[1] Chiefly from Dock's "Materia Medica for Nurses."

Abbreviation.	*Latin.*	*English.*
Dur. dolor.	durante dolore	while the pain lasts
Ejusd.	ejusdem	of the same.
Empl.	emplastrum	plaster.
F.	....	Fahrenheit.
Fl.	fluidum	fluid.
Fol.	folia	leaves.
Ft.	fiat	let there be made.
Garg.	gargarisma	a gargle.
H. d.	hora decubitus	at bedtime.
H. s.	hora somni	at sleeping time
Inf.	infusum	infusion.
Lin.	linimentum	liniment.
Liq.	liquor	liquid, a solution.
Lot.	lotio	lotion.
M.	misce	mix.
Mist.	mistura	mixture.
N. b.	nota bene	note well.
No.	numero	number.
Noc.	nocte	night.
Ol.	oleum	oil.
O. m.	omni mane	every morning.
Omn.	omni	every.
Ov.	ovum	egg.
Part. vic.	partibus vicibus	in divided doses.
P. c.	post cibum	after a meal.
Pil.	pilula	pill.
Ppt.	....	precipitate.
P. r. n.	pro re nata	when required.
Pulv.	pulvis	powder.
Q. d., or q. i. d.	quater in die	four times daily.
Qq. hor.	quaque hora	every hour.
Q. s.	quantum sufficit	sufficient quantity.
Quotid.	quotidie	daily.
℞	recipe	take.
Rad.	radix	root.
Rect.	rectificus	rectified.
Sat.	....	saturated.
S. fr.	spiritus frumenti	whisky.
Sig.	signa	let it be written down.
Sinap.	sinapis	mustard.
Sine	sine	without.
Sol.	....	solution.
S. o. s.	si opud sit	if necessary.
Sp.	spiritus	spirit.
Sp. gr.	....	specific gravity.
Stat.	statim	immediately.
Sum.	sumendum	let it be taken.
S. v. g.	spiritus vini gallici	brandy.
Syr.	syrupus	syrup.
T. d., t. i. d.	ter in die	thrice daily.
T. d. s.	ter in die sumendum	let it be taken thrice daily
Tinct., tr.	tinctura	tincture.
Troch.	trochiscum	lozenge.
Ung	unguentum	ointment.

Abbreviation.	*Latin.*	*English.*
Ut dict.	ut dictum	as directed.
Ves.	vesica	the bladder.
Vesic.	vesicular	a blister.
Vin.	vinum	wine.

FAMILIAR PREPARATIONS

A nurse should also be familiar with the composition of commonly used medicines and medicinal preparations, known under popular names:

Name.	*Composition.*	*Dose.*
Basham's mixture.	Tincture of the chlorid of iron, dilute acetic acid, solution of acetate of ammonia, with elixir of orange, glycerin, and water.	℥ss–j, diluted.
Brown mixture.	Compound licorice mixture. Licorice, paregoric, wine of antimony, spirits of nitrous ether.	ʒj–℥ss
Calomel.	Mild chlorid of mercury.	gr. j–v
Cream of tartar.	Potassium bitartrate.	gr. xxx–ʒij
Dover's powder.	Compound opium powder. Opium, 1 grain, ipecacuanha, 1 grain, sugar of milk, 8 grains.	gr. v–x
Elixir iron, quinin, and strychnin.	Syrup of the phosphate of iron, quinin, and strychnin.	ʒj–ij, diluted.
Fellow's syrup (unofficial).	Syrup of the hypophosphites, *i. e.*, of iron, quinin, strychnin, calcium, manganese, and potassium.	♏xxx–ʒj
Fowler's solution.	Liquor potassii arsenitis: 5 minims represents $\frac{1}{24}$ grain of arsenic.	♏j–x, diluted.
Gray powder.	Mercury with chalk.	gr. j–v
Gregory powder.	Compound rhubarb powder.	gr. xv–ʒj
Hoffman's anodyne.	Compound spirits of ether: ether, alcohol, and ethereal oil.	ʒj–ij, in ice-cold water.
Laudanum.	Tincture of opium.	♏v–xx (adult).
Magendie's solution (not official).	A solution of morphin sulphate, 2 grains to 1 dram.	♏x = gr. $\frac{1}{3}$ of morphin.
Mindererus, spirits of.	Liquor of the acetate of ammonia.	ʒj–iv, diluted.
Muriatic acid.	Hydrochloric acid (dilute only used).	♏v–xx, diluted.
Paregoric.	Camphorated tincture of opium. Opium, 2 grains in 1 ounce, with camphor, benzoic acid, and oil of anise.	℥ss–j (adult).

Pills	A. B. and S.	Aloes, belladonna, cascara, strychnin.	Pil. j–ij
	Blaud's.	Iron and carbonate of potassium.	Pil. j–iij
	Blue.	Blue mass, mercury with licorice, etc., pill, 3 to 5 grains of the mass equalling $\frac{1}{3}$ grain of mercury.	Pil. j–ij
	Lady Webster.	Aloes and mastic.	Pil. j–ij
	Plummer's.	Compound pill of antimony, $\frac{1}{2}$ grain, jalap, 1 grain, and calomel, $\frac{1}{2}$ grain.	Pil. j–ij
Prussic acid.		Hydrocyanic acid (dilute only used).	♏j–ij, diluted.
Salts	Epsom.	Sulphate of magnesia.	ʒij–℥j
	Glauber's.	Sulphate of soda.	ʒj–℥j
	Rochelle.	Potassium and sodium tartrate.	ʒij–iv
	Seidlitz.	Blue packet: Sodium bicarbonate, 40 gr. Rochelle salts, 2 dr. White packet, tartaric acid, 25 gr.	The packets are dissolved separately, then poured together, and taken effervescing.
Tartar emetic.		Antimony and potassium tartrate.	As an emetic, gr. ss.
Tully's powder.		Morphin sulphate, 1 grain to 1 dram with camphor, licorice, and carbonate of lime.	gr. x = $\frac{1}{6}$ of morphin.
Wine of antimony.		Contains tartar emetic, 2 grains to the ounce.	♏v–ʒss

For External Use

Blue stone.		Sulphate of copper (solid).
Carron oil.		Lime-water and olive oil, equal parts of each.
Dakin's solution.		Solution of sodium hypochlorite. Distinguished from Labarraque's solution by being free from any trace of caustic soda.
Friar's balsam.		Compound tincture of benzoin.
Goulard's extract.		Solution of the acetate of lead.
Labarraque's solution.		Liquor sodæ chlorinatæ, sodium carbonate and chlorinated lime.
Lunar caustic.		Nitrate of silver stick.
Monsell's solution.		Solution of subsulphate of iron.
Phenol.		Carbolic acid.
Washes	Black.	Calomel, 1 dram, to lime-water, 1 pint.
	Yellow.	Bichlorid of mercury (corrosive sublimate), $\frac{1}{2}$ dram, to lime-water, 1 pint.
	Red.	Sulphate of zinc, 2 grains, to water, 1 ounce, colored with tincture of lavender.

ADMINISTRATION OF DRUGS

Drugs may be administered for either their general action on the system or for a local action on one part of the system. Commonly, a drug taken into the system acts in two ways, direct or near, and indirect or remote.

Drugs are absorbed into the system through the following channels:

1. The alimentary canal (*the mouth and rectum*).
2. The respiratory system (*inhalation*).
3. The lymphatic system (*hypodermic injection*).
4. The arterial system (*intravenous injection*).
5. The surface of the skin (*inunction and fumigation*).

Drugs are also applied externally for their local effect, as anodynes, counterirritants, etc. (See Local Application, Chap. XI.)

Administration by mouth is the common method, and is that understood when the dose of a drug is stated without qualification.

Medicines, except oily preparations, are diluted with water unless ordered to the contrary. Sufficient water to make the medicine palatable and no more is the usual indication. Minerals and other drugs irritating to the tissues should be well diluted, especially the preparations of iron, arsenic, and the dilute acids.

Pills, tabloids, and capsules should be swallowed with water to help in dissolving them. If not perfectly fresh, pills and tabloids are better crushed and mixed with water before administering. Powders should be dissolved in water before giving. The few official preparations that are insoluble in water may be floated on the top of a spoonful of water, or taken directly on the tongue and swallowed with water. Unpalatable powders may be mixed with syrup, jams, or honey. Salts of mineral waters are taken well diluted, and are more efficacious if taken in warm water. An exception, however, is made in administering salts by the Matthew Hay method to

dispel dropsy. Salts are then given in concentrated doses.

To make an oil palatable it may be given with orange wine, sherry, or brandy, or the oil may be shaken into an emulsion with double the quantity of hot milk or black coffee. To suck a slice of lemon before and after a dose of castor oil will generally take away the taste. A piece of ice sucked just before taking a dose will minimize a disagreeable flavor.

Certain drugs are liable to discolor or otherwise injure the enamel of the teeth, and should be invariably taken through a glass drinking tube. The special drugs to be guarded against are iron in all fluid forms, the iodids, and the dilute acids.

The **ward medicine chest** contains glass measures, graduated by drams to 2 ounces, minim measures for doses under one dram, pipets for measuring doses ordered by drops, or *guttæ*, and *not* by minims, and glass tubes through which such drugs, etc., that discolor or corrode the teeth should be taken. Separate glasses should be kept for oily mixtures.

The time-honored rule of reading the label on a bottle three times should be practised until it becomes a habit. The rule is to read the label on taking the bottle from its place, before pouring the medicine, and again on replacing the bottle. In pouring, the bottles should be held with the label uppermost to avoid soiling the label with drippings. In measuring, the graduate is held so that the eye is on a level with the line marking the quantity.

In ward nursing care is necessary to prevent a dose being given to the wrong patient. Most hospitals have some rule or method to lessen the risk of such occurrences. The colored card system is probably the most widely used.

Different colors denote the different hours at which medicines are to be given, thus: Red, four-hourly, red with some additional mark, such as a corner cut off, two-hourly; blue, six-hourly, and blue with a corner off, three-hourly; yellow before food, orange after food, green

three times a day, and plain white cards for special orders. On the card is written the patient's name, the hour, the medicine, and dose, thus:

WARD A.
12. 4. 8.
John Smith.
———
Tinct. digitalis,
10 minims in water.

The cards are written out by the head nurse from the order-book or head-board, and are kept in separate packets, according to color, in the medicine closet. At the hour the nurse places the cards in a row in front of her, measures out each medicine, and covers the glass with the card, which is not removed until the medicine reaches the patient. The packet of cards is then placed on the head nurse's table, as an indication that the medicines have been given. The head nurse should keep a memorandum of the number there should be in each packet, so that she can tell at once if any have been forgotten. When a medicine is discontinued, the head nurse tears up the card. This system also saves the daily writing out of long lists of medicines to be given, a considerable item in a large ward.

It is important that medicines should be given at the hour at which they are ordered. If a dose for any reason is omitted, a note in writing should be made of the fact, stating the reason. When a dose has been omitted, the omission cannot be rectified by giving a larger dose at the next time.

By Rectum.—Administration by rectum is employed when, for general or local causes, feeding by the stomach is not possible: for example, in persistent vomiting, gastric ulcer, stricture of the esophagus, in some operations on

the mouth or on parts of the alimentary canal, and occasionally in conditions of coma and delirium. Drugs are also given by rectum to apply local remedies or to relieve local conditions, such as constipation, tympanites, or diarrhea. The absorptive power of the rectum is less than that of the stomach; in consequence, the dose by rectum is usually *twice that given by mouth*, unless the drug is exceptionally powerful.

Drugs are given by rectum, by enema, by douche, or by suppository, the patient lying with the legs flexed either in the dorsal position or on the left side. (See Enemata.)

Hypodermic Injection

Drugs are given by hypodermic injection when immediate action is required, or in place of rectal administration, when giving by mouth is impracticable for the reasons just stated. The drug is taken without alteration directly into the circulation by the lymphatic vessels: for this reason the dose is usually *half the quantity given by mouth.*

Concentrated solutions of the active principle of a drug are used for hypodermic injection. For this purpose the drug is usually put up in the form of small tabloids, readily dissolved in a few minims of water. Stimulants, such as brandy and ether, are given by hypodermic undiluted, and camphor in two or three drops of sweet oil.

Hypodermic injections are given in two ways, superficially, *i. e.*, directly under the skin, or deep, into the muscular tissue. The rule used to stand that drugs irritating to the tissues were given deep into a muscle, and those without irritating properties, by the superficial method. At the present day the deep method is in favor for all drugs with the exception, perhaps, of morphin, atropin, and strychnin, which, for convenience sake, are frequently given in the fleshy part of the upper arm. Drugs in common use that are specially irritating to the tissues are ergotin, digitalin, mercury, arsenic, and camphor.

Certain drugs are administered by hypodermic injection to act as local anesthetics during operations or painful

surgical procedures. At the present day *novocain* is the drug generally employed for this purpose. It is a synthetic preparation, not related to cocain, but so called on account of the similarity of its action. It is preferred as less toxic than cocain or other substitutes. Though a prompt and powerful local anesthetic, the effect passes quickly. To rectify this drawback adrenalin (4 drops to 60 c.c. of novocain) may be added immediately before the injection is given; this is equivalent to 1 in 40,000 adrenalin.

Novocain is sterilized by boiling five minutes, adrenalin by boiling one minute.

The preparation may be obtained in tablets containing novocain .05 grams and suprarenin .00083 grams. Two tablets dissolved in 2 c.c. of distilled water give a 5 per cent. solution. The strength used is 1, $\frac{1}{2}$, and $\frac{1}{4}$ per cent.; for the average operation about 100 c.c. is required. A special hypodermic syringe of a large size is used; small quantities of the drug are distributed under the skin all over the area to be anesthetized. Novocain may also be used as a general anesthetic in *spinal anesthesia,* in which case very small concentrated doses are given. (See p. 330.)

Other drugs used as local anesthetics are cocain, eucain, and a preparation of cocain containing morphin, known as Schleich's solution. For these drugs a long hypodermic needle is chosen, and introduced immediately under the skin or mucous membrane, below the line of the proposed incision; the needle is withdrawn a little at a time, and a few drops of the solution injected at each stop. The injection should be completed five minutes before the operation.

Cocain is used for this purpose in the strength of 0.5 to 1 per cent. in sterile distilled water. From 1 to 2 grains is the usual dose. Schleich's solution, of which there are three formulas, is given in a larger quantity of fluid, sufficient to produce edema of the part.

Drugs for Hypodermic Injections.—The following is a table of the drugs most commonly given by hypodermic:

Drug.	Average Dose.	Derivation.	Chief Effect of the Drug.
Morphin sulphate.	gr. $\frac{1}{12}$–$\frac{1}{4}$	Alkaloid of opium.	Anodyne and hypnotic.
Atropin sulphate.	gr. $\frac{1}{100}$–$\frac{1}{60}$	Alkaloid of belladonna.	Powerful stimulant, especially to the respiratory centers.
Apomorphin hydrochlorid.	gr. $\frac{1}{10}$, repeated in ten minutes if not effective.	Prepared from morphin by the action of hydrochloric acid.	Powerful emetic, used when poisons have been swallowed, provided the stomach has not been injured.
Strychnin sulphate.	gr. $\frac{1}{60}$–$\frac{1}{20}$	Alkaloid of nux vomica.	Cardiac respiratory and nerve stimulant.
Nitroglycerin.	gr. $\frac{1}{200}$–$\frac{1}{100}$	....	Cardiac stimulant, lowering blood-pressure by dilating the arteries.
Cocain hydrochlorid.	gr. $\frac{1}{8}$–$\frac{1}{2}$	Alkaloid of coca.	Cardiac stimulant, more frequently used in less concentrated form to induce local anesthesia.
Novocain.	ℨiij of $\frac{1}{4}$ to $\frac{1}{2}$ per cent. solution.	Synthetic preparation.	Local anesthetic.
Pilocarpin hydrochlorid	gr. $\frac{1}{8}$–$\frac{1}{4}$	Alkaloid of jaborandi.	Powerful diaphoretic.
Hyoscin hydrobromid.	gr. $\frac{1}{100}$–$\frac{1}{50}$	Alkaloid of hyoscyamus.	Cardiac and respiratory stimulant, powerful hypnotic.
Brandy.	♍x–xxx	....	General stimulant.
Ether.	♍x–xxx	....	General stimulant.
Oil of camphor.	♍iij–vj	....	Stimulant, especially of the nervous system.

Antitoxin Serums.—(See Chapter XIV.)
Hypodermoclysis.—(See Chapter XIV.)
Lumbar Injections.—(See Chapter XIV.)
Intravenous Injections.—(See Chapter XIV.)

On the continent of Europe it is quite customary to give almost all drugs, including even irritants, such as iron, arsenic, and digitalis, by hypodermic or "piqûre," in preference to by mouth. The drugs are put up each separate dose in a tiny glass vial, hermetically sealed, and opened by breaking off the slender neck: the needle is attached directly to the neck by a small piece of rubber tubing.

There are two preparations of digitalis in use for hypodermic injection—an American preparation, digita*line*, of which the dose is $\frac{1}{75}$ to $\frac{1}{50}$ grain, and a German preparation, digita*lin*, of which the dose is $\frac{1}{12}$ to $\frac{1}{8}$ grain. Since

Fig. 129.—Hypodermic tray.

the difference of the dose is so great, it is highly important to be certain which preparation is being used.

To give a hypodermic injection it is necessary to prick the surface of the skin, thus opening what may prove a channel of infection if proper precautions are not observed. The hands of the operator and the area to be pricked must be surgically clean, the syringe, needle, and injection sterile (Chap. XIV). At the same time it is important that the technic employed should be simple and take up no unnecessary time. A small tray arranged with all necessary articles for the operation should form part of the equipment of the medicine cupboard. This consists of an alcohol lamp, a spoon, the syringe, a bottle of alcohol, a small covered jar for sterile gauze sponges,

another for needles, a small glass or gallipot, matches, the tabloids of the drugs used in small stoppered bottles or glass tubes. The needles may be kept in shot, emery powder, or between layers of gauze, and should invariably be kept threaded with wire when not in use, the wire coming well beyond the point. If the syringe is entirely of glass, with solid glass piston, it is sterilized by boiling.

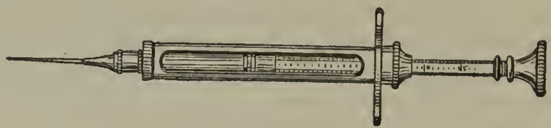


Fig. 130.—Ordinary glass and metal hypodermic syringe (Morrow).

The syringe in general use has rubber washers, which are injured by boiling; it is best prepared by soaking in alcohol before use. Proceed as follows:

1. Fill the syringe with alcohol; pour some into the gallipot, and leave the syringe to soak for a few minutes.
2. Wash your hands.
3. Boil the needle over the alcohol lamp in the spoon without the wire.

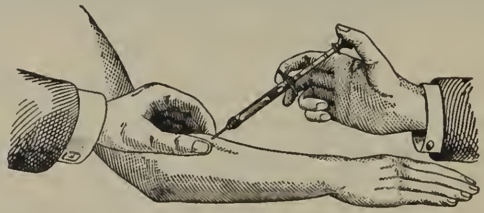


Fig. 131.—Method of giving a hypodermic injection (Thornton).

4. Empty the syringe and draw up about five minims of the boiled water.
5. Unscrew the top and shake in from the vial a tabloid of the required dose; it will dissolve readily. *A drug should never be boiled.*
6. Take the needle with a sterile gauze sponge and join to the syringe. Keep the sponge round the needle until actually to be used.

7. Hold the syringe upright, and press the piston gently until a drop appears at the point. This is to expel the air.

8. Soak a gauze sponge in alcohol, carry it and the syringe to the patient. The alcohol sponge is to cleanse the site of the puncture. It should be rubbed briskly over the surface until the skin is well reddened; this removes superficial grease and epithelium from the area, and the increased blood-supply brought to the surface promotes quick absorption of the drug.

In giving a hypodermic superficially, the usual site is the fleshy part of the upper arm. A piece of flesh is pinched between the finger and thumb and the needle introduced in a slanting direction. In giving the injection deep, the muscles of the buttock or the thigh are generally chosen. The skin is stretched tightly over the part and the needle plunged straight into the tissues. Care must be taken that the puncture is not made over a superficial vein or too near a bone, or the periosteum may be injured. The needle is inserted nearly to its full length and then withdrawn slightly while the injection is made. The injection is given gently. As the needle is withdrawn the gauze sponge is pressed over the puncture and held in place a few moments. A few moments' light massage round (*not over*) the site of puncture will hasten the absorption of the drug.

Care must be taken to use a sharp needle: a blunt one causes unnecessary pain. Careless technic may result in the infection of the part and the formation of an abscess at the site of the puncture.

INHALATION—ANESTHESIA

Volatile drugs may be administered by *inhalation*, either for general or for local effects.

The general systemic effects obtained by inhalation are:

1. General anesthesia.
2. Stimulation of the general circulation.

Anesthesia.—The administration of drugs for the purpose of general anesthesia can be taught *only* by many

careful demonstrations from an expert anesthetist, followed by closely supervised practice. Wherever practical it should be taught, as emergencies arise, both in private nursing and in the smaller hospitals, where a nurse may be required to act as anesthetist. Moreover, at the present day, both in hospital work and in private practice, nurses are proving themselves exceedingly reliable as anesthetists, and several of the leading hospitals have nurses in these positions, with very satisfactory results.

The anesthetics in most frequent use are nitrous oxid gas, chloroform, and ether, and derivatives from ether, such as ethyl chlorid, ethyl bromid, and such patent preparations as antidolorin, etc.

Nitrous oxid gas is used where very short anesthesia is necessary, as in dentistry, opening an abscess, etc. The

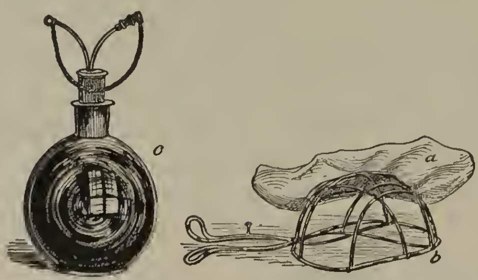


Fig. 132.—Esmarch chloroform-inhaler: *a*, Stockinet cover, to be held tense by *b*, wire frame; *c*, dropping-bottle (De Nancrede).

mouth and nose are covered with a rubber mask connected by a tube with a tank containing the gas; the gas is inhaled directly from the tank. Consciousness is lost in less than three minutes, and recovered as quickly when the gas is removed. There are usually no after-effects, as in other forms of anesthesia.

Gas and Oxygen.—By means of a special apparatus, *nitrous oxid gas* in conjunction with *oxygen* can be used for prolonged periods, two hours or more. This means of anesthesia is favored for emergency operations, where the patient cannot be thoroughly prepared, and in conditions

where ether is contra-indicated. Gas is not so irritating as ether, but is more depressing and relaxation is not so complete. Where complete relaxation is needed for a short time ether can be substituted and replaced by the gas and oxygen as soon as the necessity is passed.

Fig. 132*a*.—Teter nitrous oxid gas and oxygen apparatus.

Several patent apparatus are on the market, such as the Teter, the Ohio monovalve, and the S. S. White (Philadelphia). Full directions are sent with either machine.

Chloroform.—Although not so widely used as ether, chloroform is preferred in some conditions. It is pleasanter to take than ether, recovery is quicker, and the after-effects are less disagreeable. It is not considered so safe as ether on account of its depressant effect on the heart; on the other hand, it is less irritating to the respiratory organs and to the kidneys. It is largely used in obstetrics,

a very little chloroform producing insensibility to pain without the muscular relaxation of complete anesthesia, which would delay labor.

Chloroform is given on a special "mask," a convex wire frame, a convenient size for fitting over the mouth and nose, over which a piece of flannel is stretched (Fig. 132). The mask is held in front of the mouth and nose, and the chloroform dropped from the drop bottle. The nose and lips are smeared with cold cream or vaselin, to prevent blistering if the chloroform should accidentally come in contact with the skin.

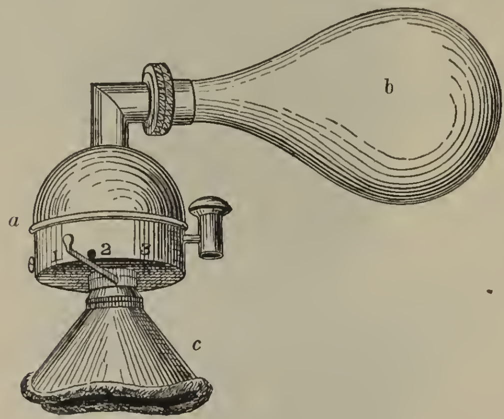


Fig. 133.—The Clover ether inhaler (Morrow).

Accidental death occurring during chloroform anesthesia is due to paralysis of the heart; the *pulse*, therefore, must be closely watched.

Ether.—Ether is the anesthetic chiefly used in America in surgery. It is unpleasant to take, and comparatively slow in its action; for this reason nitrous oxid gas is often given as a preliminary. It is safer than chloroform, as it acts as a stimulant to the heart and respiration. The after-effects are unpleasant, though considerably less so when the ether is skilfully given. The common effects are nausea, vomiting, violent "swimming" headache, and constipation. Ether is administered by the *closed* or the *open* method.

Closed Method.—For the closed method a special apparatus, known as the Clover inhaler, is generally used (Fig.

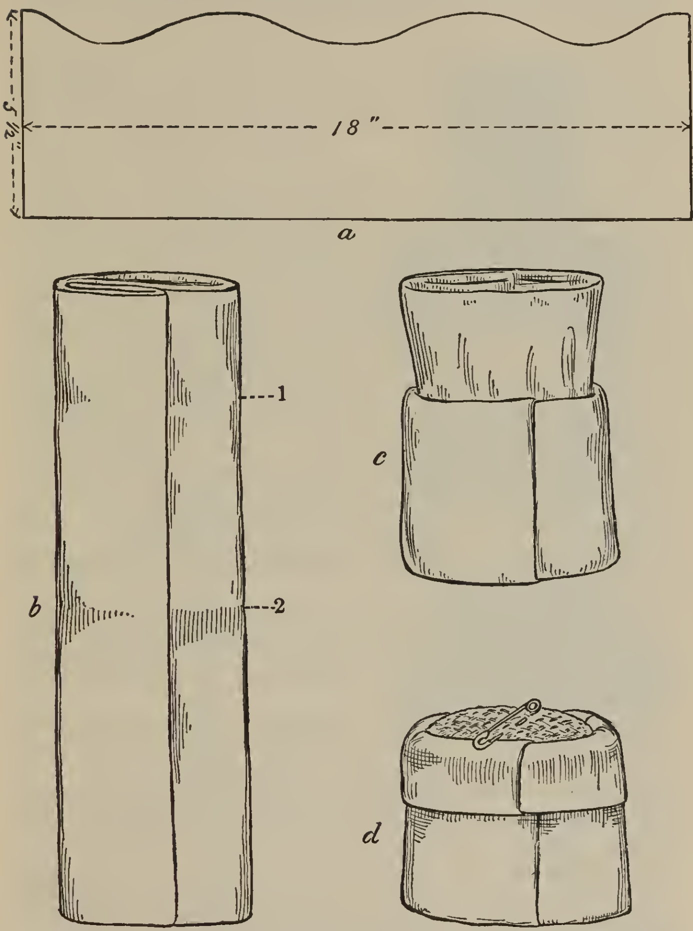


Fig. 134.—Ether cone: *a*, Cardboard; *b*, towel with cardboard rolled inside from points 1 to 2; *c*, long end of towel drawn through the cone; *d*, cone complete, with gauze sponge pinned in (Massachusetts General Hospital).

133). The ether is contained in a reservoir (*a*) connected with a large rubber bag (*b*), from which a tube leads to a

rubber face-piece (*c*). The face-piece is fitted closely over the mouth and the nose, the patient breathing thus directly from the rubber bag. Fresh air is admitted now and then by removing the face-piece.

The open method of giving ether is to drop the ether on a folded towel, holding it at a short distance from the patient's face. This method is very slow and wastes much of the ether.

The *semi-open method*, although slower than the closed, is considered safer, and generally preferred. The ether is dropped on a piece of gauze placed at the apex of an open cone, the base of which is held down over the patient's nose and mouth. Various cones are used for this method; one of the simplest (Fig. 134) is made as follows: Take a piece of cardboard 18 inches long by 5½ inches wide. Fold like a cuff, overlapping 6 inches, and shape one margin with a pair of scissors to fit over the chin and nose; the folded cuff is 12½ inches round. Place the folded cardboard on a dressing towel, so that on one side of the cuff there are three or four inches of towel, and, on the other, half of the width of the towel. Roll up tightly.

Turn the narrow margin of the towel inside the edge of the cuff.

Push the wide margin of the towel through the cuff, and turn down over the outside. Make the edge of the towel into a firm little roll; this makes a convenient grip to hold the cone in place.

Lay a large gauze sponge inside the cuff at the straight edge, and fasten in place with a safety-pin.

The cone is held down firmly over the nose and mouth, fitting closely round the chin; the ether is dropped on the gauze sponge.

Intratracheal Etherization.—In operations on the jaw, mouth, and other parts of the face ether is most conveniently administered by the *intratracheal method*. In the methods of etherization, just described, the ether vapor is inhaled through the air-passages as in the ordinary act of breathing. By the intratracheal method the vapor is forced into the lungs through the trachea by *insufflation* or *positive pressure*. A special apparatus for intratracheal

etherization is patented by Dr. Samuel Robinson, and other models and modifications are in use. These various apparatus appear somewhat complicated, but they consist of three essential features whose uses are readily appreciated.

1. The *ether tank*, a glass vessel containing a small quantity of ether, which is placed in a second vessel containing hot water, acting as a water-bath, by which the ether is kept at a temperature of about 60° C. In the S. Robinson apparatus the water-bath stands on a flat electric stove regulated to maintain the required temperature.

2. The *insufflation apparatus*, by which the ether vapor, combined with a percentage of oxygen, is blown into the trachea. This is attached to the ether tank and consists of a pair of bellows worked by the foot; in the Samuel Robinson apparatus the bellows are replaced by a small electric motor.

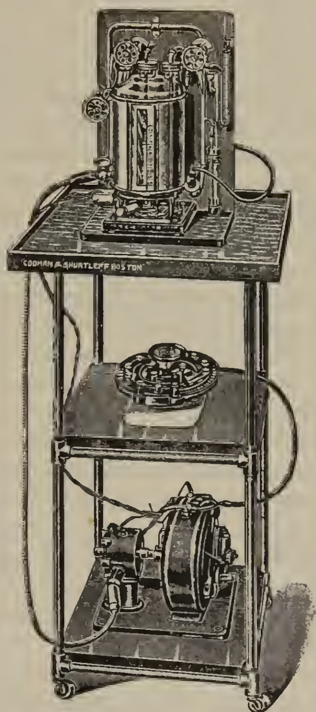


Fig. 134*a*.—Dr. Samuel Robinson's apparatus for thoracic surgery under intratracheal insufflation or positive pressure.

3. A *rubber tube* from the ether tank, to which is attached a glass nozzle if the ether is to be given through the mouth, or a rubber nasal tube if it is to be given through the nose. This takes the place of the usual ether mask.

During intratracheal etherization the pharynx is packed with *wet* gauze. This ensures that the ether vapor enters the trachea and considerably lessens the gastric irritation common to etherization.

In giving ether in this way it is necessary that the vapor should be warmed, as it is blown directly into the lungs without passing through the nasal passage, where the air to be breathed is warmed on its way to the trachea. By this means the risk of pneumonia is lessened; it is also found that when warmed a smaller quantity of ether is required to produce the effect.

Stages of Ether Anesthesia.—In administering ether three stages are noticed:

First: Primary Anesthesia.—The patient is semiconscious, the muscles are not relaxed, the face is flushed, the pulse quick, but regular, the pupils dilated, but react to light (the last condition may be absent if morphin has been given). Following this stage is an *intermediate stage*, in which the patient is highly excited, frequently violent, and extremely difficult to restrain.

Second: Surgical Anesthesia.—The patient is profoundly unconscious, the muscles are quite relaxed, though never *absolutely* (for example, some spasm is present in the perineal muscles), the pulse is quick and regular, but less quick than in the primary stage, the respirations are *slow*, *deep*, and *regular*, the pupils are contracted, but still react. It is during this stage that surgical operations are performed. In certain conditions, as in operations on the perineum, it may be necessary to push the anesthetic further, but, speaking generally, the patient is not allowed to go beyond this stage.

It is important to bear in mind that in giving ether the quality of the *breathing* is the most reliable guide to the patient's condition: as long as the respirations are slow, deep, and regular, the danger stage has not been reached.

Third: Profound Anesthesia.—This stage is fatal if continued; the muscles are absolutely relaxed, respirations are rapid and become quickly shallow, the pulse is rapid and may be irregular, the skin pale and clammy, the pupils again dilate and do not react. In a fatal case the breathing stops before the pulse. Hemorrhage occurs from the absolute relaxation of the muscular walls of the blood-vessels. If this stage has been accidentally reached, the ether must be instantly removed, and means

taken to restore the patient. The usual means are artificial respiration, fresh air or oxygen, and stimulants by hypodermic injection, especially *atropin* ($\frac{1}{100}$ to $\frac{1}{75}$ grain), which is the most powerful respiratory stimulant known.

An accident that may occur in administering a general anesthetic is to allow the tongue to fall back over the glottis and thus cutting off the supply of air. To prevent this the head is kept to one side and the jaw held forward. A pair of forceps should always be at hand to pull the tongue outside the mouth if such an accident happens.

Examination Before Anesthetizing.—Before an anesthetic is given, there is always a preliminary examination of the heart, the lungs, and the kidneys (the latter by examination of the urine). Ether is a local irritant: it produces little effect on healthy tissue, but is excessively irritating to diseased organs. For this reason ether as an anesthetic is contraindicated when either kidneys or lungs are unhealthy, and chloroform is frequently given instead.

Chloroform is depressing to the heart; it is, therefore, contraindicated when there is any weakness of that organ. If chloroform is pushed to a fatal conclusion, the pulse fails before the respirations.

Preparations derived from ether, such as ethyl chlorid or ethyl bromid, are also much in use as anesthetics for minor operations, where muscular relaxation is not necessary, in place of nitrous oxid gas, and may also be preferred to chloroform in obstetric work. They are given by the open method, on a piece of folded gauze or a towel.

Local Anesthesia.—In cases where pain is slight or of momentary duration, *local* anesthesia is used instead of general anesthesia, and may, conveniently, be considered here.

The operation may be conducted with the part immersed in water as hot as can be borne; this is, obviously, only practical in a limited way, as in minor operations on a hand or foot. More commonly the local site is superficially frozen by some such substance as ether. Ethyl chlorid and similar preparations are put up in sealed glass tubes, fitted with a special metal cap held by a spring over a very fine opening. On inverting the tube and opening the cap, a fine jet of the preparation is

thrown on to the skin. The part is anesthetized when the skin is *whitened.*

Local Anesthesia by Novocain, Cocain, Etc.—(See p. 320.)

Spinal Anesthesia.—General anesthesia may also be produced by injecting the spinal fluid with one of the drugs having a "local" anesthetic property. Usually novocain is used, a small dose in a strong solution (generally 2 c.c. of a 5 per cent. solution). Sensation is lost, but the patient retains his consciousness completely. Under spinal anesthesia quite extensive operations are performed, but the method is not in general use. (See Lumbar Puncture, page 512.)

Inhalation for Stimulation.—For purposes of general stimulation some drugs are also administered by inhalation. The fumes of *ammonia* may be inhaled through the nose, causing direct stimulation of the nerve-centers that govern the act of respiration and the action of the heart; they afford relief in syncope and some forms of headache. The ordinary smelling-salts are prepared from ammonia, rock-salt crystals, and some aromatic perfume. Any pungent odor, such as that of burnt feathers, may produce the same effect.

Inhalation of the vapor of *amyl nitrite* causes prompt dilatation of the arteries, thus lowering the blood-pressure and relieving distressed cardiac conditions. It is the common remedy in attacks of cardiac asthma or of angina pectoris. The best preparations are the nitrite of amyl *pèrles:* small sealed glass capsules containing 3 minims of the drug. The capsule is broken in a fold of gauze or a handkerchief, and held to the nostrils. If placed thus in a tumbler, and the tumbler held over the mouth and nose, none of the fumes are lost.

Inhalations are largely used for local action on some part of the respiratory system. The drugs are used dry, as smoke, or given in steam.

To relieve *asthma* various patent apparatus are sold, containing either stramonium or potassium nitrate (saltpeter), in convenient form for vaporizing.

An economic preparation of saltpeter for inhalation is made as follows: A saturated solution of the drug is

made in boiling water, and a sheet of white blotting-paper placed to soak in the solution. When thoroughly saturated, the blotting-paper is hung up to dry and then cut into convenient strips. A strip at a time, placed on a plate and set alight, will smolder slowly, giving off the fumes of saltpeter, soothing the irritated tissue of the trachea, and thus relieving the spasmodic respirations. The fumes may be directed toward the patient's face by means of a cone improvised from a piece of stiff paper. The leaves of stramonium can be burnt in the same way.

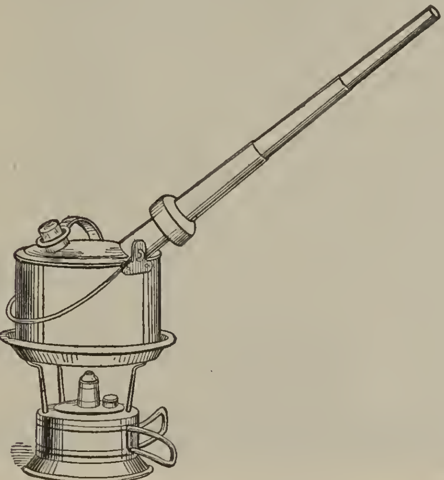


Fig. 135.—Croup kettle (J. P. C. Griffith).

Steam inhalations are used to relieve spasmodic breathing, to disinfect bronchial secretions, and to stimulate expectoration. Plain boiling water may be used, or the water may contain some drug with one or other of these properties.

Special closed kettles are sold for the purpose, fitted with a long straight spout and a small opening for filling. The steam is under low pressure, and is emitted from the spout in a steady stream. They can be heated over an alcohol lamp or gas-stove, and kept at steaming-point for hours, thus carrying on the treatment without inter-

mission. In place of adding the drug to the boiling water, a small sea-sponge may be kept soaked with the drug and secured at the mouth of the spout. The drugs most frequently used in this way are benzoin, eucalyptus, and creosote. In giving an inhalation in this manner, the bed must be carefully screened, and the spout of the kettle

Fig. 136.—A movable croup tent made of gas-piping and dimity curtains. The frame is quite separate from the bed, which it entirely surrounds. A canopy curtain also covers the top when necessary. By substituting black curtains, a dark cabinet (for eye cases, etc.) is contrived (Polyclinic Hospital, Philadelphia).

directed inside the screen. In hospital wards some adequate means of screening is always at hand. Rods of gas-piping screwed to the four posts and connected by cross rods at the top make a satisfactory frame on which cotton curtains can be hung, one across the entire top, forming a canopy. The kettle stands outside. The spout enters the curtained space at the side of the bed, and is directed toward the patient's face.

Such a screen can be improvised from a clothes-horse, over which sheets are securely pinned. The upper half of the bed is sufficient to inclose. The sheet forming the canopy is made to hang down in front, *about half way to the mattress*, and being pinned to the screen on either side, a screened space sufficient for practical purposes is formed.

Where continuous treatment is not necessary, the inhalation may be given conveniently from a pitcher or with one or other of the patent inhalers.

A small pitcher, well warmed, is *half* filled with boiling water, and the drug added. A towel is then folded round the top, leaving an opening which is placed over the mouth and nose, and the patient breathes in the steam. The principle of any patent inhaler is the same: the pitcher is merely made in a convenient shape and fitted with a mouth-piece.

Special inhalations for the *throat* are frequently ordered merely warm, and in others the vapor is produced by chemical reaction, and should not be heated at all.

When the drug is required for local application to the throat or the posterior nares, the throat spray is often preferred to the inhaler, in order to apply the remedy without the relaxation of the parts caused by the steam. In spraying the posterior nares, the tip of the nose is pushed upward, and the spray directed straight backward, not up the nose, as is generally attempted.

INUNCTION

Drugs are absorbed through the surface of the skin by inunction only in a limited way. The drug may be blended with an oil or an ointment and rubbed over the surface until it is absorbed.

Cod-liver oil or olive oil is used as an inunction for marasmic infants or delicate children. The oil should be warmed and the abdomen washed previously with hot soap and water and dried. The oil is rubbed into the abdominal wall by the palm of the hand, using a circular movement. Mercury is very commonly given to syphilitic patients by inunction. One-half to one dram of mercurial

ointment is given at a time. As the mercury irritates the skin, it should not be rubbed into the same spot on consecutive days. The usual sites for mercurial inunction are as follows: Right axilla, left axilla, space in front of the right elbow, space in front of left elbow, inner surface of the right thigh, inner surface of left thigh. In carrying out the treatment these spaces are used in rotation on successive days; a day is then allowed to elapse, and the cycle begun again in the same order. In rubbing, the bare hand should not be used, or the operator may absorb the drug. A smooth glass stopper from a wide-mouthed bottle makes a convenient rubber. Mercurial inunction is usually given in connection with a course of sweat-baths. It should be given after the bath when the pores are open.

Fumigation is more rarely used. The patient is arranged as for a vapor-bath (see Baths); over the lamp, instead of the kettle of water, is placed a metal plate containing the drug to be vaporized. Mercury is the principal drug administered in this manner, but, generally speaking, inunction is preferred.

CHAPTER X

POISONS AND THEIR ANTIDOTES

A POISON is described as a substance " which, if taken into the system, produces disease or death." The large majority of medicines, if taken in excessive doses, act as poisons. It seems, therefore, essential that nurses should, in administering medicines, be familiar with the symptoms that denote overdosage.

Symptoms of poisoning may arise from the actual accumulation of an excessive quantity of a drug in the system, especially in patients suffering from dropsy (see p. 698) or from the drug having been pushed until what is known as the "physiological limit," or the limit of the normal toleration of the drug is reached.

On the first appearance of any such symptom the drug is withheld; frequently no other treatment is necessary, but in some conditions, such as digitalis poisoning, the physical symptoms are severe and require careful treatment.

Differing from the above are the cases in which the poisoning is caused by an overdose of a powerful drug, either through carelessness or from suicidal intent. The condition is one of acute poisoning, and calls for prompt treatment.

In the **treatment of poisoning** three steps are to be observed: (1) Get rid of the poison. (2) Administer the antidote. (3) Treat the physical symptoms.

If the poison has been taken by mouth, the first step is to empty the stomach, either by lavage or by the administration of an emetic, following which the antidote is given.

A *chemical antidote* is a substance, frequently a drug, that acts directly on the poison in the stomach and renders it

inert. It has no effect on any part of the poison already absorbed into the system.

A *physiologic antidote* is a drug or substance that counteracts the effects of the poison on the general system. For example, in poisoning by opium, either permanganate of potash or tannic acid is given as the chemical antidote. It converts the opium actually in the stomach into an inert and harmless mass. Atropin in its physical effects is the direct antagonist to opium. Opium depresses the respiratory centers, atropin is a powerful respiratory stimulant; opium increases perspiration by checking other secretions, atropin checks perspiration and stimulates the secretion of urine; the effect of opium on the nervous system is shown in pinpoint pupils, of atropin, in widely dilated pupils. In cases of poisoning by opium, atropin, therefore, is given as the physiologic antidote.

A physiologic antidote must always be administered with caution, or one poison may be substituted for another.

Lavage may be given with plain warm water, but more commonly the chemical antidote is used as a lavage, about half a pint being left in the stomach after any repetition of the process. In some cases it is necessary to repeat the lavage at intervals of twenty to thirty minutes. Once the chemical antidote is considered to have produced its effect, the stomach is usually washed out with plain warm water. The reason for this is that the inert mass formed by the poison, combined with the antidote, may, by the action of the digestive secretion, become dissolved, and the poison once more be set free.

Emetics.—Warm soapy water, salt and warm water (2 drams to 1 pint), or mustard and warm water (2 drams to 1 pint) are domestic emetics commonly obtainable. One or two glassfuls are usually effectual. If mustard is used, it should be followed by plain water, to prevent irritation to the lining of the stomach. Other safe emetics, generally at hand in hospital work, are as follows:

Sulphate of zinc, 15 grains in a tumbler of warm water, repeated, if necessary, in fifteen minutes.

Carbonate of ammonia, 30 grains in a tumbler of warm water or milk, repeated, if necessary, in fifteen minutes.

Ipecacuanha wine, 4 drams to 1 ounce, every quarter of an hour until the result is obtained.

Apomorphin is a powerful emetic, used when prompt emesis is necessary or where the patient is unable to swallow. It is given as a hypodermic injection, in doses of $\frac{1}{10}$ grain. It is usually effective in about five minutes. If no result is shown in ten minutes, the dose is repeated—generally the second dose is effectual.

Where the nature of the poison is known, the treatment of the condition is simple. In many cases the patient is not seen until unconscious, and no history is obtainable. The objective symptoms are then of the first importance in determining the diagnosis. The following points should be noted: The physical condition, whether stimulated or depressed; the presence of pain, vomiting, and the appearance and smell of the vomitus; nervous symptoms, such as sleep, unconsciousness, delirium, or convulsions; the smell of the breath; contraction or dilatation of the pupils; marks of burns about the lips and mouth.

In carrying out the treatment care must be taken never to exhaust the patient. In cases where collapse has already occurred, or where the poison used has a depressing action on the heart (aconite, digitalis, etc.), lavage is used in preference to emetics, and the patient should be kept lying down during the process, with the head low.

It must be borne in mind that most poisons are eliminated by the intestines and the kidneys, and both should be kept active. If urine is suppressed, the catheter should be passed, as there is some possibility of the poison excreted by the kidney being reabsorbed from the bladder.

In all cases of poisoning it should be a rule that all the urine passed should be saved for examination and carefully measured. The vomitus also should be kept, as an aid to diagnosis.

Poisons may be considered in three groups:

Corrosive.—Those that corrode or destroy the tissues with which they come in contact.

Irritants.—Those that irritate the tissues. Taken in large quantities or in concentrated form, the irritants will act as corrosives on the tissues.

Functional Poisons.—Those that act on one or other of the organs, interfering with their function, and causing direct and indirect physiologic symptoms.

CORROSIVE POISONS

The common corrosive poisons are the acids—acetic, carbolic, citric, hydrochloric (muriatic), hydrocyanic (prussic), nitric, oxalic, sulphuric (vitriol), tartaric—and the alkalis—ammonia, lime, caustic potash, carbonate of soda (washing-soda), and nitrate of potash (saltpeter).

Many of the above are given in small, highly diluted doses, as medicines, chiefly tonic in their action.

Symptoms.—The general symptoms of poisoning by corrosives are: Corrosion of the mucous membrane lining the mouth, esophagus, and stomach, evinced by whitening and burns about the lips and mouth, the injury frequently being so severe as completely to destroy the membranes; acute pain in mouth and abdomen; vomiting, usually of mucus and blood, and acid or alkaline in reaction, according to the nature of the poison; bloody stools; frequently bloody frothing at the mouth; giddiness; rapid collapse; coma, or sudden failure from paralysis of the heart. Convulsions may occur. Perforation of the stomach or intestines is not uncommon.

Poisoning by corrosives is the most fatal form of poisoning. In severe cases (nitric acid, sulphuric acid, or strong alkalis) death occurs rapidly from shock and the local effect of the corrosive. Partial recovery may take place, and the patient die eventually either from the local or physiologic effects of the poison. If recovery takes place, scarring of the tissues is a common cause of stricture of the esophagus. Death may also result from starvation caused by injury to so large a surface of the alimentary canal.

A **routine treatment** is common to all forms of corrosive poisoning.

Emetics are rarely used, the violent muscular contraction caused by emesis tending to injure the tissues further.

Lavage is given promptly, where possible (*i. e.*, unless the local injury is too severe), and should contain the antidote.

The natural antidote to an acid is an alkali. In poisoning by the acids the alkalis—lime, chalk, magnesia (sulphate), or soda (sulphate)—are given as a lavage or as drinks stirred up in milk. Warm soapy water is a convenient alkaline lavage.

The natural antidote to an alkali is an acid. Vinegar and water is used as a lavage, and the dilute acids, vinegar, or lemon-juice in water, are given by mouth.

The antidote is followed by oil (exception, carbolic-acid poisoning), milk, the white of eggs, and bland drinks, such as flaxseed tea or barley-water.

External heat is applied, and stimulants given by hypodermic. Morphin is usually necessary to allay the pain.

Convalescence is slow. The diet should consist of milk, egg-albumen, and bland drinks. The kidneys are usually in an irritated condition, and the urine should be measured and examined. Strychnin and other cardiac stimulants are given by hypodermic.

Certain **special points** should be carefully remembered.

In poisoning by *carbolic acid*, the antidote, *alcohol*, is given freely as a lavage and by mouth.

Neither oils nor glycerin can be given, as they dissolve the acid and promote its absorption.

In poisoning by *oxalic acid* (usually taken by mistake for Epsom salts) either *lime or chalk* of the alkalis should be used, the union of some of the others forming poisonous compounds.

Of the acids, *sulphuric acid* and *nitric acid* have the most violent corrosive action on the tissues, in concentrated form completely destroying the membranes. The symptoms are violent, the collapse profound and rapid. Perforation frequently results. The vomitus is stained characteristically *tarry* from sulphuric acid, and *yellow* from nitric acid.

THE MORE COMMON CORROSIVE POISONS

Poison.	Physical Symptoms.	Chemical Antidotes.	Treatment and Physiologic Antidotes.
Acids:			
Hydrochloric. Nitric. Phosphoric. Sulphuric.	Burns about the lips and mouth; acute pain from mouth to stomach; dyspnea; collapse rapid and frequently fatal; sometimes hematemesis and purging, with bloody stools. Death may occur suddenly from perforation or hemorrhage, as well as from the physical effects of the drug.	An alkali—lime-water, soda, chalk, whitewash, soapy water—by mouth, or by lavage if unconscious.	Recumbent position, with the head low; external warmth; fresh air; cardiac stimulants by hypodermic, oil, milk, and egg-albumen by mouth; morphin by hypodermic for pain.
Acetic. Oxalic. Tartaric.	Same as above.	Lime or chalk in water or milk by lavage.	Same as above
Carbolic.	Same as above, together with scanty, dark-colored urine, contracted pupils, collapse very rapid.	Alcohol (whisky, etc.) by lavage and by mouth. Lime-water.	Same as above. No oils. Barley-water and gruels.
Hydrocyanic.	Usually almost instant death.	Alkaline lavage if time permits; emetic of soapy water	Artificial respiration: alternate affusion of cold and hot water to face and spine; external heat; stimulants (atropin) by hypodermic and inhalation.
Alkalis:			
Ammonia. Caustic potash. Caustic soda. Lime. Nitrate of potash.	The same physical symptoms. The injuries to the tissues are still more severe.	Lemon-juice, vinegar, and other vegetable acids in water, by mouth or lavage.	Treatment as in poisoning by acids. In ammonia poisoning, especially, fresh, cold air should be allowed plentifully.

In poisoning by *hydrocyanic acid* death usually occurs too rapidly for treatment. Collapse is sudden. There may be convulsive movements of the toes and fingers, or complete muscular relaxation. The eyes are usually prominent and the pupils dilated. If there is time, the treatment consists in artificial respiration, cold and hot water dashed alternately on the spine and in the face, external heat, and stimulants by hypodermic.

IRRITANT POISONS

The larger proportion of the irritant poisons are the *metals*, such as alum, antimony, arsenic, copper, lead, mercury, silver nitrate, and zinc. Other irritants are iodin, cantharides, phosphorus, and turpentine. The fumes of certain gases are also considered as irritant poisons.

A certain similarity may be noticed in the physical symptoms following poisoning by the metals and other irritants.

The **physiologic dose** is characterized by digestive disturbance, diarrhea with cramping pains, salivation, frequently coryza, and, in the case of the metals, by a metallic taste in the mouth.

Poisonous doses cause acute burning pain at the epigastrium, colic, vomiting, and purging, with watery stools. The vomitus and the stools may contain blood. Prostration is marked, and severe cases frequently end in fatal collapse. Nervous symptoms are common, such as muscular cramps, especially in the legs, convulsions, or some form of paralysis. The kidneys are irritated, the urine scanty, albuminous, or bloody, and frequently suppressed.

The *chronic* form of poisoning is associated with anemia, emaciation, muscular weakness, local paralysis, and digestive disturbances.

Acute Poisoning.—In the treatment of acute poisoning the stomach is emptied either by emetics or by lavage. The chemical antidote is usually some soluble sulphate or egg-albumen. It should be administered promptly, and usually in repeated doses. For the reasons already stated,

a lavage of plain water should follow the administration of the chemical antidote once the effect of the antidote is established.

The further treatment common to all cases of acute poisoning by the irritants consists in hot applications to the abdomen, stimulants administered by hypodermic injection, and external heat. The recumbent position is enforced, and, where the heart is much depressed, as shown by a small, feeble, irregular pulse, the bottom of the bed should be elevated and the head kept low. Opium is frequently necessary to relieve the acute pain, and is ordered in extreme cases; it is, however, avoided, if possible, on account of its constipating properties, which hinders the prompt elimination of the poison. Opium is not, as a rule, given where the poison causes marked symptoms of congestion of the kidneys. Castor oil is commonly given to hasten the elimination of the poison. Egg-albumen, milk, and bland drinks are given, as in the treatment of corrosive poisoning. Oil may also be given for its soothing effect on the tissues, except in poisoning from cantharides or phosphorus. As with carbolic acid, oil dissolves these substances and makes them more readily absorbable.

As many of the irritant poisons are in common use as medicines, nurses should be familiar with the symptoms of *intoleration*, as well as with the symptoms and treatment of poisonous doses. For convenience, the two are described together.

Convalescence from the acute poisoning is always very slow, and death may occur after the lapse of several days.

Prolonged rest in bed cardiac stimulants, and soft diet until the tissues are quite healed, are the common lines of treatment. If the kidneys are affected, no nitrogenous foods are given until the urine is normal. In these cases the urine must be measured and examined daily.

Sequelæ, such as nephritis, local paralysis, pronounced anemia, and other physical manifestations, such as jaundice (in phosphorus-poisoning), may follow poisoning by one or other of the irritant poisons.

Poison.	Preparations and Average Dose.	Physical Symptoms.		Chemical Antidote.	Treatment, Including Physiologic Antidote.
		Intolerance.	*Acute Poisoning.*		
Alum.	External use.	. . . .	Usual symptoms of irritant poisoning (see *Arsenic*).	Carbonate of ammonia as emetic; lavage of sulphate of magnesia.	Usual treatment of irritant poisoning (see *Arsenic*).
Antimony.	Tartar emetic, $\frac{1}{12}$ grain; wine of antimony, 5 to 30 minims. Tartar emetic is also an ingredient in compound syrup of squills ($\frac{3}{4}$ grain in 1 ounce).	Soft pulse, general depression, muscular relaxation, vomiting, profuse perspiration.	Usual symptoms. *Special symptoms,* profound and rapid collapse, muscular cramps.	Tannic acid given by lavage (10 grains to 1 pint). Strong tea.	Usual treatment. *Special treatment,* no emetic; alcohol in full doses; the head kept low on account of the cardiac depression; opium generally necessary.
Arsenic.	Fowler's solution, 1 to 10 minims; arsenous acid, $\frac{1}{40}$ grain. Taken with suicidal intent in Paris-green or rat's-bane.	Puffiness and itching of the eyelids on awakening; nausea; metallic taste; colic, diarrhea. Chronic poisoning (from fumes, etc.), anemia; gastric disturbances; debility; neuritis.	Acute burning pain in epigastrium; violent vomiting; purging, with watery, frequently bloody, stools; thirst; colic; urine scanty, containing albumin or blood, and sometimes suppressed; collapse frequently fatal. Sometimes complete unconsciousness, convulsions, and rapid death.	Sesquioxid of iron, one tablespoon in milk or water, at repeated intervals of about ten minutes. (To prepare the above, combine tincture of the chlorid of iron with half a pint of ammonia water until no more precipitate forms; turn the precipitate on to a piece of gauze, and wash under cold water to remove the ammonia: the antidote is then ready for use. It cannot be relied upon if the arsenic has been taken in a solid form (*i. e.*, rat's-bane).	Emetic. Lavage of plain water after the antidote has been given; recumbent position; stimulants by hypodermic (atropin, etc.); external heat; hot applications to abdomen; bland drinks (milk, flaxseed tea, barley-water) and egg-albumen; opium to relieve pain; castor oil to eliminate the poison. Chronic poisoning treated with removal of the cause, good hygiene, nourishing food, and, usually, iron.

Poison.	Preparations and Average Dose.	Physical Symptoms.		Chemical Antidote.	Treatment, Including Physiologic Antidote.
		Intolerance.	*Acute Poisoning.*		
Cantharides.	External use.	. . . .	Absorbed from blister: headache, nausea, rise of temperature, congestion of the kidneys, albuminuria, hematuria. Taken internally, usual symptoms. *Special symptoms*, muscular cramps, salivation, congestion of the kidneys, sometimes convulsions.	No chemical antidote.	Taken internally, usual treatment. *No oils*; as in carbolic poisoning they aid in the absorption of the drug; opium also avoided on account of the kidney condition. Magnesium sulphate as aperient. Hot baths and packs. If from absorption, the blister is removed and the part washed with soap and water.
Copper.	Blue-stone, external use. Sulphate of copper, $\frac{1}{16}$ to $\frac{1}{4}$ grain, or as emetic, 3 to 6 grains.	Chronic, from fumes, etc., in some factories; debility, gastric disturbances, jaundice.	Usual symptoms. *Special symptoms*, metallic taste, frequently jaundice, coma.	Potassium ferrocyanid, if it can be obtained at once. Egg-albumen, flour-water. Antidote followed by lavage of plain water.	Usual treatment.
Iodid of potash (KI).	5 grains to 1 dram, well diluted in milk, or with aromatic spirits of ammonia.	Puffy eyelids, coryza, malaise, rise of temperature, salivation, sore throat, difficulty in swallowing, gastric disturbances, acne rash.	. . . .	. . . .	*Intolerance*, withdrawal of drug, mouth-wash and gargle of chlorate of potash; digestive disturbances treated with diet and purgatives.
Iodin.	Tincture of iodin. External use.	. . . .	Usual symptoms. *Special symptoms*, vomitus stained yellow, or bluish if starchy food has been taken.	Starch, as starch-water, or flour-water, followed by plain lavage.	Usual treatment.

Lead.	Lead and opium pill. Lotion for external use.	Usually chronic, from working with lead, known as *painter's colic*. Also from adulterated food, or water contaminated by lead pipes. Most prominent symptoms are anemia, colic, muscular weakness, wrist-drop, and a blue line around the gums.	Usual symptoms.	Sulphate of magnesia as lavage or emetic.	Usual treatment. *Chronic form:* free purging, usually with sulphate of magnesia; liberal diet, including eggs, milk, and lemon-juice. Potassium iodid is usually given to hasten elimination.
Mercury.	Calomel, $\frac{1}{10}$ to 5 grains. Blue-mass, 3 to 5 grains. Gray powder, 2 to 5 grains. Bichlorid of mercury, $\frac{1}{50}$ to $\frac{1}{20}$ grain. Iodid of mercury, solution of bichlorid of mercury, 1:1000 to 1:10,000 for external use.	Metallic taste, salivation, tender gums, sore throat, gastric disturbances; later, vomiting and purging, rise of temperature, spongy gums, loose teeth, ulceration of mouth, anemia, and nephritis.	Usual symptoms. *Special symptoms*, metallic taste, white appearance of mucous membranes, congestion of the kidneys, frequently suppression of the urine.	Egg-albumen, followed by lavage of plain water. Where the quantity taken is known, one egg is given for every four grains of the poison.	Usual treatment. *Special treatment*, apomorphin as emetic. Lavage or emetic repeated frequently after administering the antidote. Castor oil. Opium may be necessary. Potassium iodid frequently given in after-treatment. Milk and egg-albumen the only diet until the urine is normal.
Phosphorus.	Dilute phosphoric acid, 10 to 20 minims. Syrup of hypophosphites, 1 to 2 drams. Acute poisoning, usually from sucking matches or from vermin pastes containing phosphorus.	Depression, increase of urine and perspiration. Chronic (as in match factories) may result in necrosis of bones, especially of the jaw, and changes of tissues in various organs.	Usual symptoms. *Special symptoms*, vomitus with odor of garlic; excreta and vomitus luminous at first, later coffee-ground vomit from altered blood. Jaundice occurs from about the third day. Death may result suddenly or after several days, occasionally after two or three weeks.	Crude French turpentine or *old* oil of turpentine, given in tablespoonful doses every ten or fifteen minutes, followed by lavage. Sulphate of copper, 3 grains every five minutes, as emetic; after emesis, every twenty minutes, as long as necessary, in half-grain doses.	Usual treatment. Repeated lavage. *No oils;* as in carbolic and cantharides poisoning they promote the absorption of the poison.

Poison.	Preparations and Average Dose.	Physical Symptoms.		Chemical Antidote.	Treatment, Including Physiologic Antidote.
		Intolerance.	*Acute Poisoning.*		
Silver nitrate.	$\frac{1}{4}$ to $\frac{1}{2}$ grain in pill form. Silver stick, solution of silver nitrate, external use.	Gastric disturbances, irritation of kidneys, irregular heart's action. Taken internally for length of time, nitrate of silver gives to the subcutaneous tissue a permanent bluish discoloration.	Usual symptoms.	Common salt as emetic or lavage (2 drams to the pint).	Usual treatment.
Turpentine.	Oil or spirits, 5 to 30 minims in capsule or on sugar. More commonly for external use in stupes or liniments.	. . . .	Usual symptoms. *Special symptoms,* congestion of the kidneys, imparts odor of violets to the urine. Death is not common.	No chemical antidote.	Usual treatment. *Special treatment,* prompt and repeated lavage of plain water. Hot baths and packs, etc., to relieve the kidney condition.
Zinc.	Principally for external use, as ointment, powder, or lotion. Zinc sulphate, $\frac{1}{10}$ to $\frac{1}{2}$ grain; as emetic, 15 to 20 grains.	Chronic form, from factories, etc., resembling chronic lead-poisoning.	Usual symptoms. *Special symptom,* violent vomiting.	Tannic acid, strong tea, carbonate of soda, lime-water, or soapy water as lavage.	Usual treatment. Vomiting should not be checked.
Gases: Carbonic acid. Charcoal. Chlorin. Illuminating.	Exposure to fumes.	. . . .	Asphyxia.	Oxygen.	Removal from the fumes. Fresh air, artificial respiration, stimulants by hypodermic. Hot coffee enema.
Chloroform. Ether. Nitrous oxid.	By inhalation.	. . . .	Asphyxia. General anesthesia. Fatal accidents in administering chloroform are usually due to paralysis of heart; in ether, to paralysis of the respiration.	. . . .	As above. The tongue pulled well forward, the head low. Cold affusions to face and chest. Battery, atropin, strychnin by hypodermic, amyl nitrite by inhalation.

The **chronic forms** of poisoning (arsenic, lead, copper, etc.) are treated by withdrawal of the cause, good hygiene, rest, and nourishing diet. Local paralysis is treated with massage, and, usually, the alkaline tonics are prescribed.

THE FUNCTIONAL POISONS

The large majority of the functional poisons belong to the vegetable kingdom. All of them are in constant use as medicines; the early recognition of the full physiologic effect of each drug is of importance.

The treatment of the toxic condition is governed by the effect produced by the drug.

Lavage or emetics are employed to empty the stomach. In a number of cases, especially in poisoning by the vegetable alkaloids, tannic acid is the chemical antidote (10 grains to 1 pint). It is given as a lavage, repeated from time to time, some of the solution being left in the stomach after each lavage, and a final lavage of plain water; or it may be given by mouth in repeated doses, a glassful at a time every ten minutes, followed finally by lavage of plain water. Tannic acid may also be given in the form of very strong tea.

Permanganate of potash is also a common antidote, especially for the vegetable alkaloids, and is used in the same manner as tannic acid. Sufficient of the crystals to color the water dark pink is the usual strength.

The alkaloids of many of these drugs are commonly given by hypodermic, and it is obviously futile to empty the stomach. Reliance must then be placed on counteracting the physical symptoms. An exception is met with in some drugs which are actually excreted in the stomach, of which *opium* is an important example. The same is true in cases where the toxic condition is due to an accumulation of the drug in the system, as already explained, the individual dose being harmless. In many cases also by the time the effects of poisoning are manifested little of the poison remains in the stomach, and to administer emetics or lavage is merely unnecessarily exhausting.

These drugs are excreted in the urine and by the bowels.

Elimination is hastened, therefore, by keeping the kidneys and the bowels active. Urine should not be allowed to accumulate in the bladder or the drug may be reabsorbed from the urine. If the urine is not passed voluntarily, the catheter should be used. The urine should in all cases be saved for examination.

Many of the functional poisons have an intensely depressing effect on the heart; for example, aconite, digitalis. In the treatment of these cases a small exertion on the part of the patient may cause a fatal syncope. Where possible (*i. e.*, unless there is the condition of orthopnea), the recumbent position must be enforced and the head kept low. Emetics must be avoided, and lavage given with caution. If emesis occurs, the vomitus should be received on a towel without the head being raised. In the treatment of all poisons, and especially of poisons belonging to this class, the strength of the patient must be carefully husbanded. Besides the recumbent position and external warmth, the treatment commonly comprises the giving of a cardiac stimulant by hypodermic or rectum, and infusion of normal salt solution.

On account of the importance of these drugs as medicines and their very varied effects, the symptoms and treatment of overdose and poisoning is given at greater length.

Aconite.—*Action.*—Depressant, lowering the rate and volume of the pulse; sedative, diuretic, diaphoretic, antipyretic.

Preparations.—Tincture of aconite (1 to 4 minims); aconitum ($\frac{1}{200}$ to $\frac{1}{50}$ grain).

Physiologic Dose.—Pulse small, soft, slow; respiration slow, deep; vertigo, weakness; sensation of tingling on the tongue.

Treatment.—Withdrawal of drug; the recumbent position; no sudden movements; cardiac stimulants.

Poisonous Dose.—Tingling sensation; pulse very slow and irregular (30 to 40); respiration slow and irregular; temperature subnormal; muscular weakness, profound depression, sweating; frequently vomiting; dilated pupils; finally, collapse.

Treatment.—Lavage with tannic acid; external heat; the recumbent position with the head low; stimulants, especially atropin, on account of its prompt action; infusion of normal salt solution. Artificial respiration may be necessary. The greatest care must be taken not to exhaust the patient or in any way tax the depressed heart.

After-treatment.—Rest in bed until the pulse is normal. Digitalis and alcoholic stimulants are usually ordered.

Alcohol.—Intoxication by alcohol in any form produces exal-

tation, staggering gait, deep sleep with stertorous breathing, acute gastritis, and, finally, profound depression.

Treatment.—Emetics or lavage. Gastric symptoms treated by diet and purgatives. Death may occur from paralysis of the heart, and has been known to take place several days after recovery has apparently been assured.

Antipyrin.—*Action.*—Reduces temperature, relieves mild nervous conditions, such as migraine, sleeplessness, etc.

Preparation.—Powder (5 to 15 grains).

Physiologic Dose.—In full or too frequent doses produces marked depression, with syncope, cyanosis, feeble, irregular pulse, rapid respiration, and collapse. A skin eruption often resembling the rash of measles is common.

Acetanilid (*antifebrin*) and preparations containing acetanilid—*antikamnia, antinervine,* etc.—and *phenacetin* produce effects similar to *antipyrin.*

Treatment.—Recumbent position, external heat, stimulants, hot coffee, rest in bed until the pulse is normal.

In large amounts taken accidentally antipyrin and its derivatives are corrosive poisons.

Belladonna.—*Action.*—Deliriant, respiratory and cardiac stimulant; antispasmodic; anodyne; checks all secretion except urine; dilates the pupils.

Preparations.—Tincture of belladonna (10 to 30 minims); atropin sulphate ($\frac{1}{200}$ to $\frac{1}{75}$ grain). Atropin and its derivative, homatropin, are used as mydriatics.

Physiologic Dose.—Dryness of the nose and throat, pulse rapid and full, excitement, dilated pupils, rise of temperature, saliva and sweat checked, thirst, skin rash suggesting scarlatina.

Treatment.—Withdrawal of the drug; water freely; cold sponging or packs; sedatives, such as the bromids, may be necessary.

Poisonous Dose.—All the above symptoms intensified. Wild and noisy delirium. In fatal cases convulsions, paralysis, and coma.

Treatment.—Lavage with the *chemical antidote,* tannic acid. Cold sponging or packs, ice-bag to head. In collapse, coffee and brandy enema, external heat, normal salt infusion. Morphin, the *physiologic antidote,* may be given by hypodermic. Pilocarpin may be ordered to induce sweating, and, more rarely, physostigma, or its alkaloid, eserin, is given. If morphin is not used, the bromids are generally given.

Chloral.—*Action.*—Narcotic; antispasmodic; depressant.

Preparations.—Chloral hydrate (10 to 20 grains); chloralamid (15 to 30 grains).

Physiologic Dose.—Sleep, syncope, cyanosis, irregular pulse. Chloral should always be given with caution. An ordinary dose has been known to cause death from paralysis of the heart.

Treatment.—Fresh air, rousing, stimulants, friction of extremities, external heat.

Poisonous Dose.—Profound sleep, passing into coma; pulse at first slow, feeble, and irregular, later rapid and thready; respiration slow and shallow; subnormal temperature; syncope; cyanosis; clammy skin; pupils first contracted, then widely dilated. Death occurs from paralysis of the heart.

Treatment.—Lavage with strong coffee or tea; fresh air; rousing; recumbent position, *with the head low;* external heat; stimulants, especially atropin or strychnin, by hypodermic; hot coffee and

alcoholic stimulants by mouth or enema; amyl nitrite by inhalation, oxygen; the electric battery; artificial respiration. The patient must be spared all exertion.

Cocain Hydrochlorid (Alkaloid of Coca).—*Action.*—Stimulant, deliriant. Chiefly used as a local anesthetic by hypodermic injection. Acts also as a mydriatic.

Preparation.—In solution, 2, 4, etc., per cent. As a stimulant, $\frac{1}{8}$ to $\frac{1}{2}$ grain.

Poisonous Dose.—Excitement, incoherence, nausea, vomiting; later, marked depression, with small, rapid pulse, slow respiration, cyanosis, dilated pupils, and syncope or collapse.

Treatment.—Lavage of plain water (if taken by mouth). In collapse, recumbent position, external heat, alcoholic stimulants, coffee enema, amyl nitrite inhalations, artificial respiration, saline infusion. The physiologic antidote is opium, given as morphin sulphate by hypodermic injection. Cocain is also a drug which induces a habit.

Digitalis.—*Action.*—Cardiac stimulant and tonic; diuretic.

Preparations.—Tincture of digitalis (5 to 20 minims); infusion, (1 to 4 drams); digitalin ($\frac{1}{30}$ grain).

Physiologic Dose.—Headache, nausea, vomiting, diarrhea, disturbances of vision, slow, full pulse, becoming rapid on slight exertion.

Treatment.—Withdrawal of drug, recumbent position, alcoholic stimulants, or strychnin.

Poisonous Dose.—The above symptoms intensified. Small, irregular pulse, with "wild" heart, protruding eyes, with blue tinge to the whites, marked prostration, and collapse.

Treatment.—If a poisonous dose has been taken (rare), prompt lavage with tannic acid. The recumbent position absolutely (except in orthopnea), external heat, stimulants, especially alcohol and strychnin. All exertion must be avoided until the pulse is restored.

Hyoscyamus resembles belladonna in its action and toxic effects. The treatment of poisoning by hyoscyamus or its preparations is the same as in belladonna-poisoning (see Belladonna).

Mushroom-poisoning has marked depressing action on the system, causing collapse, cyanosis, and syncope, with small, feeble pulse and shallow respiration; vomiting and purging may be present.

Treatment.—Lavage with tannic acid; hot strong tea; external heat. Alcoholic stimulants, coffee and brandy enema, saline infusions. Physiologic antidote is atropin, $\frac{1}{100}$ to $\frac{1}{50}$ grain.

Opium.—Many alkaloids, of which the principal are morphin, codein, and heroin. Morphin only has narcotic action.

Principal Preparations.—Tincture of opium, 20 to 30 minims; camphorated tincture of opium or paregoric, 1 to 4 drams (contains opium, 2 grains in each ounce); morphin sulphate, $\frac{1}{12}$ to $\frac{1}{4}$ grain; Dover's powder (contains opium, 1 grain in every 10 grains), 5 to 10 grains.

In acute opium-poisoning there are three stages, with characteristic symptoms.

First stage: happy, sleepy, painless state, passing into sleep.

Second stage: sleep from which the victim can be roused. *Slow respirations;* pulse slow and full; skin flushed and dry; contracted pupils; retention of urine.

Third stage: profound sleep, passing into coma; *respiration very slow* and shallow, toward the end, two to four a minute; rapid pulse, generally thready, cyanosis; clammy sweat; pin-point pupils; just before death the pupils dilate widely.

The most important symptom to watch in opium-poisoning (and all narcotic poisoning) is the *rate of the respiration.* Where the rate does not sink below 10 to 12, the chances of recovery are good, and any improvement in the rate of respiration is always a favorable symptom. In administering opium in any form nurses should be taught to report at once any drop in the rate of respiration.

Treatment.—Chemical antidotes, permanganate of potash or tannic acid, given as lavage or in a weak solution by mouth.

The treatment aims at stimulating the respiratory and cardiac centers, and the urgency of the treatment is guided by the condition of the respiration and pulse. If both are good, the patient is allowed to sleep off the effects of the poison. Commonly, drastic treatment is necessary. The patient is kept awake by constant movement, cold water dashed in the face and over the spine, black coffee by enema and mouth; fresh air is supplied freely; artificial respiration and electricity may be necessary. *Atropin* is the physiologic antidote, and is given by hypodermic in doses larger than the average; alcoholic stimulants and strychnin may also be used. If the urine is not voided, the bladder must be emptied to prevent reabsorption of the drug from the bladder. From the first and second stages recovery is usual, the third stage once reached is generally fatal.

Stramonium.—Alkaloid, *daturin.* In its action and toxic effects resembles belladonna. The treatment of the poisoning is the same as in belladonna (see Belladonna).

Strychnin.—Alkaloid, strychnin sulphate.

Action.—General nerve stimulant and tonic acting on all the important nerve-centers.

Preparations.—Tincture nux vomica (about 2 per cent. strychnin), 5 to 20 minims; strychnin sulphate, $\frac{1}{60}$ to $\frac{1}{20}$ grain.

Physiologic Dose.—Given over lengthened periods or in too full or too frequent doses, strychnin produces excitement, overstimulation of the special senses, especially hearing, cardiac disturbance, and muscular twitchings beginning at the fingers and toes.

Treatment.—Withdrawal of the drug, rest (in bed if the symptoms are severe), freedom from strain and excitement; the bromids are given and pushed until the full effect is obtained.

Poisonous Dose.—In poisonous quantities, usually taken with suicidal intent, strychnin produces typical convulsions resembling those of tetanus or lock-jaw, with certain marked differences. (See p. 669.) The convulsion begins at the extremities and quickly involves the whole frame; the jaws are the last to be affected; between the convulsions the muscles are completely relaxed; the eyes remain open and staring; the mouth has a horrible grin; consciousness is maintained to the end.

Treatment.—Prompt lavage with the chemical antidote, tannic acid, or emetic followed by tannic acid or animal charcoal; inhalation of chloroform during convulsions; chloral and bromid in full doses by enema or stomach. The bladder must be emptied—by catheter, if necessary. Absolute quiet is imperative, a slight sound causing a fresh convulsion; in collapse, external heat, saline infusion, and alcoholic stimulants are given.

Veratrum Viride.—*Action.*—Cardiac depressant, reduces pulse both in strength and frequency.

Preparations.—Tincture of veratrum viride, 2 to 10 minims. Frequently ordered 2 minims every hour until the desired effect is produced.

Poisonous Dose.—Complete prostration, nausea, and violent vomiting. The pulse is first abnormally slow and soft, later small, rapid, and thready. As emesis is at once produced, poisoning by veratrum is rarely fatal.

Treatment.—The recumbent position absolutely, with the head low; lavage of plain water; stimulants by hypodermic; hot coffee enema; saline infusion; external heat; friction to the extremities.

Some drugs which have not a toxic effect produce characteristic groups of symptoms if taken for lengthened periods or in full doses. The most important are as follows:

Bromids.—*Action.*—Sedative.

Preparation.—In combination with the alkalis, potassium, sodium, etc., 10 to 30 grains.

A group of symptoms known as *bromism.* Mental and physical inertia, apathy, dulness, fetor of breath, gastric disturbance, and acne rash.

On withdrawal of the drug the symptoms usually disappear. Arsenic is sometimes given to correct the skin condition.

Quinin.—*Action.*—Tonic, antipyretic, specific in malaria.

Preparations.—Quinin sulphate (2 to 10 grains), and in combination with other drugs.

Full doses of quinin cause a sensation of ringing in the ears and deafness; skin eruptions frequently follow, either resembling urticaria or the rash of scarlet fever. The condition is called *cinchonism.*

Usually the drug is withdrawn and no further treatment is necessary. An idiosyncrasy against quinin is not uncommon. In persons with this characteristic or after an abnormally large dose, quinin may cause syncope and prostration.

Treatment.—The recumbent position; fresh air; alcoholic stimulants; strong coffee; external heat.

Salicylic Acid.—*Action.*—Antipyretic, specific in rheumatism.

Preparations.—Salicylic acid (5 to 20 grains); sodium salicylate (5 to 20 grains). Full doses produce a group of symptoms known as salicism, characterized by buzzing and roaring in the ears, deafness, headache, sense of great depression, and physical weakness. Some albuminuria is usually present. A rash, usually resembling urticaria, is not uncommon.

Treatment.—The drug is withdrawn. Rest and the moderate use of alcoholic stimulants may be necessary.

In some rare instances marked dyspnea and delirium follow overdosing by the salicylates.

Snake-bite.—The poison from a snake-bite has a rapidly depressing action on the vital centers. Free stimulation with alcohol or strychnin should be given promptly, external heat should be applied, and the recumbent position inforced. Cupping over the wound is sometimes recommended, or means to encourage bleeding. Recovery from snake-bite is not uncommon.

CHAPTER XI

ELEMENTARY BACTERIOLOGY AND THEORIES OF IMMUNITY

Classification of Bacteria, Morphology, Parasites—Examination of Bacteria—Microscope, Smear, Staining, to Stain Tubercle Bacillus, the Hanging Drop, Widal Reaction—Cultivation of Bacteria, Plating, Culture-media, to Take a Culture—Invasion of the System by Bacteria—Varieties of Toxins—Koch's Postulates—Pathogenic Organisms Already Discovered—Air-borne Infections, Droplet Infection, Water-borne Infection, Infection through the Broken Surface, by Inoculation, Transmitted by Insects—Prophylaxis of Infectious Diseases—Immunity—Natural, Acquired, Active, Passive—Vaccination, Inoculation, Antitoxins—Theories of Immunity—The Feeding Cell, Side-chain Theory, Opsonic Theory—Incubation—Protection Against Contagion in Special Infections.

CLASSIFICATION

So large a portion of our work is the practical outcome of modern research in bacteriologic laboratories, so greatly is it influenced by the theories and deductions of modern scientists, that some accurate, if elementary, knowledge of the more prominent facts of bacteriology should be available to the pupil nurse from the earliest days of her training.

Bacteriology, or the study of micro-organisms, belongs to modern times, and especially to later years, where three important factors have made possible an accurate study of the life-history of these minute bodies not possible before. These three factors are: first, the perfection of the microscope; second, the discovery of a method of *isolating* the individual organism in "*pure culture*"; and, third, the discovery of a means of differentiating micro-organisms by staining them with anilin dyes.

Bacteria are unicellular micro-organisms of *vegetable* origin. Their structure is of the simplest, consisting of protoplasm surrounded by a cell-wall and devoid of nucleus. In common with other similar micro-organisms,

they are also known as *germs* or *microbes*. They resemble the lowest form of vegetable life—the *fungi*.

Fungi differ from ordinary plant life in their method of development, in the food which they require, the conditions in which they flourish, and in the fact that they possess no *chlorophyl*. Chlorophyl is the green coloring-matter of plants which is essential to their growth. It makes possible in the plants the process of chemical change (accomplished in our bodies by the processes of digestion and assimilation), by which the plant, under suitable conditions of sunshine and moisture, can take up carbon dioxid from the atmosphere, and convert it into the essential elements of plant structure. Fungi, which have no chlorophyl, cannot live on air and water only, but require to be fed also with organic matter. Some feed on vegetable organic matter and some on animal; some varieties require the organic matter to be living; others feed only on dead matter.

According to their method of development, these vegetable micro-organisms are divided into groups:

1. **Bacteria,** or **schizomycetes,** which multiply by *fission*, a simple division of the parent cell into two. The large majority of disease-producing germs belong to this group.

2. **Molds or Hyphomycetes.**—These multiply by sporulation, a process somewhat similar to seeding, and grow as a network of fine filaments from which other threads project, bearing the spores.

3. **Yeasts or Saccharomycetes.**—These multiply by budding, the protrusion of a new cell from the parent cell. To the activity of the yeasts are due the familiar phenomena of fermentation, causing milk to sour, bread to rise, the conversion of sugar into alcohol, etc.

Few of the molds or yeasts are disease-producing. Thrush, and some varieties of skin disease, such as favus, are caused by organisms belonging partly to the mold and partly to the yeast families. In very rare conditions mold fungi are found in the lung.

Protozoa.—This is another variety of micro-organism, not of vegetable but of *animal* origin, and belonging

to the lowest known form of animal life. Malaria, syphilis, certain forms of dysentery, are among the diseases due to protozoa.

Micro-organisms that produce disease are classed as *pathogenic;* those that do not produce disease, as *non-pathogenic.* To the activity of the non-pathogenic organisms we owe many of the beneficent acts of nature. One of their functions is the breaking up of complex organisms into simple compounds—the process we know as *decay.* Thus, dead organic matter, whether vegetable or animal, is converted into gases and water, which can be used as food by plant life, the plants again, in their turn, forming food for animal life.

BACTERIA

Investigation proves that bacteria exist wherever animal or vegetable life has existed. They are found in the air, in water, and in the soil, particularly where the soil has been tilled, and may be present on any tangible object. Bacteria are constantly present in some parts of the body, especially the mouth, the different parts of the alimentary tract, and the skin. They are not, it is believed, present, in a normal condition, in the internal organs.

In order to grow, bacteria require food, moisture, and warmth. Some require oxygen as supplied by the air of the atmosphere in order to develop; others will only flourish where the air is excluded. Bacteria that require air are called *aërobic;* those that require absence of air, *anaërobic;* bacteria to the development of which one condition or the other is essential are spoken of as *obligate* or *strict;* those that flourish in either condition as *facultative.*

The food of bacteria consists of organic compounds. either vegetable or animal. Bacteria that feed on living tissue are known as *parasites;* those that feed on dead organic matter, as *saprophytes.* In feeding, the bacterial cell has the power of selection, by which it attracts those organic cells necessary for its development and repels those that destroy it. The attraction of one cell for an-

other is called *positive chemotaxis;* the reverse, *negative chemotaxis.*

The **temperature** most favorable for the growth of bacteria is the temperature of the living body; for some the temperature of the human body is most favorable, others develop in the bodies of cold-blooded animals. Since the body furnishes the right temperature, organic food, moisture, and absence of light, it forms an ideal soil for the development of bacteria.

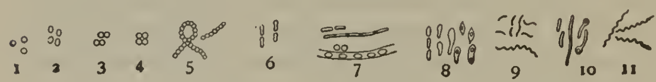


Fig. 137.—Various forms of bacteria: 1 and 2, Round and oval micrococci; 3, diplococci; 4, tetracocci or tetrads; 5, streptococci; 6, bacilli; 7, bacilli in chains, the lower showing spore-formation; 8, bacilli showing spores, forming drumsticks and clostridia; 9 and 10, spirilla; 11, spirochætæ (McFarland).

Classification by Characteristics.—Certain bacteria, by their activity, produce characteristic phenomena, and are classified according to these characteristics:

Chromogenic, those that produce *color.*

Aërogenic, those that produce *gas.*

Photogenic, those that produce *phosphorescence.*

Zymogenic, those that cause *fermentation.*

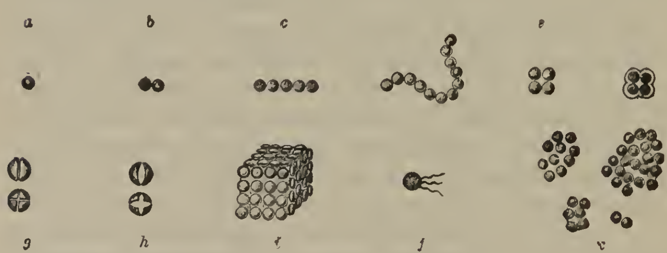


Fig. 138.—Diagram illustrating the morphology of cocci: *a*, Coccus or micrococcus; *b*, diplococcus; *c*, *d*, streptococci; *e*, *f*, tetragenococci or merismopedia; *g*, *h*, modes of division of cocci; *i*, sarcinæ; *j*, coccus with flagella; *k*, staphylococci (McFarland).

Some organisms form *acids,* such as lactic acid, butyric acid, etc., and others, *alkalis,* of which the principal is ammonia. This is often an important aid in differentiat-

ing between bacteria that otherwise closely resemble each other.

That part of bacteriology which treats of the shape and structure of bacteria is called *morphology*.

Fig. 139.—Various forms of micro-organisms: 1, Streptococci; 2, staphylococci; 3. diplococci; 4, tetracocci; 5, spirilla; 6, bacilli; 7, bacilli with spores (Paul).

Classification by Shape.—According to their shape, bacteria (*schizomycetes*) are divided into three principal groups:

1. The spherical or *coccus* (called also micrococcus).
2. The rod-shaped or *bacillus*.
3. The curved or spiral or *spirillum*.

Cocci.—The cocci may be round or oval. In their development the different varieties form characteristic groupings, according to which they are classified:

Monococci, occurring singly.

Diplococci, occurring in pairs.

Tetrads, occurring in groups of four.

Sarcinæ, occurring in cubes.

Staphylococci, occurring in clusters that resemble a bunch of grapes.

Streptococci, occurring in chains.

Bacilli.—The different bacilli vary considerably in appearance, but all retain more or less their rod-like shape;

Fig. 140.—Diagram illustrating sporulation: *a*, Bacillus inclosing a small oval spore; *b*, drumstick-bacillus, with terminal spore; *c*, clostridium, with central spore; *d*, free spores; *e* and *f*, bacilli escaping from spores (McFarland).

that is to say, they are always longer than they are broad. Some are straight, others distinctly oval; in some the ends are square, in others, round; some are short and others long. Bacilli occur as separate bodies, or grouped end to end in chains or threads. In the latter, light transverse markings may be seen, marking the outline of the individual cells. The shape of a bacillus is sometimes altered by the presence of what is known as a *spore* (see below). Where a spore forms, the bacillus bulges slightly. Thus, if a spore forms in the center, it gives to the bacillus a *spindle* shape, tapering at either end; a spore forming at one end gives to the bacillus the shape of a drumstick.

Unlike the *cocci*, *bacilli* are not usually subdivided according to their form or groupings. Many are named after the scientist who first described them, as the *Klebs-Löffler bacillus;* others are named from the disease of which the variety

is the cause, as the *tubercle bacillus*, the *typhoid bacillus;* and others again from the substance in which they flourish, as the *hay bacillus*, the *potato bacillus*.

Spirilla.—*Spirilla* may be formed of one single curve, known as *comma*, or of many curves, like a cork-screw; the latter are frequently called *spirochætæ*. *Spirilla* forming simple, wave-like lines are also called *vibrios*.

Some bacteria possess the power of *motility*. The micro-organism is provided with minute, whip-like processes, known as *flagellæ*, by the vibration of which it can move about in a fluid medium, and apparently steer itself. There may be only one flagellum, giving to the cell the appearance of a tadpole, in which case the organism is said to be *monotrichous*, or they may be distributed like a fringe, either all round the cell or in groups, in which case the organism is *peritrichous*. Micrococci are not, as a rule, motile; many bacilli and the majority of the spirilla have this property. Under certain conditions the power of motility is lost, a fact that has its weight in certain methods of diagnosis. (See Widal Reaction.) This power of motility is an independent and characteristic property of the cell, quite different from certain *oscillating* movements, which they show in common with other minute particles of matter when floating in a fluid medium.

Reproduction.—All bacteria, as has been said, multiply by *fission*, a simple division into two of the parent cell. Multiplication by fission is termed *vegetative reproduction*. This division takes place with great rapidity—sometimes in as short a time as twenty minutes. As is seen, especially in studying the micrococci, in dividing, bacteria show a tendency to form characteristic groupings and to adhere in pairs, fours, or eights, or in the form of clusters, chains, or threads.

In certain of the bacilli a second method of reproduction sometimes occurs. In the bacillus a peculiar bright, light spot is observed, generally, but not invariably, about the center. This is the *spore;* it bears to the bacillus the relation a seed has to a plant, and will, in favorable conditions, germinate and develop into an ordinary bacillus, and proceed to multiply by fission in the usual way.

Spores are very much more difficult to destroy than the ordinary bacteria, owing to the highly resistant capsule in which they are inclosed. Means for disinfection and sterilization which destroy all other forms of bacteria are ineffectual with spores. The recognition of spore formation in certain bacteria is, therefore, extremely important. Fortunately, in few of the known pathogenic bacteria does spore formation occur. Three known to possess this property are the *anthrax*, the *tetanus bacillus*, and the *bacillus aërogenes capsulatus* or *gas bacillus*.

PROTOZOA

The protozoa, being animal micro-organisms and not of vegetable origin, reproduce in a totally different manner. They resemble a very elementary form of animal life, found in swamps and stagnant water. Recent research has brought to light a curious fact in the life-history of many of the pathogenic protozoa which has revolutionized the methods of prevention of the diseases caused by these organisms. Part of the development of the protozoa takes place in man and part in the body of an insect, called in this respect the *host*. The parasite is sucked from the blood of man by the bite of the insect, and in the body of the insect only undergoes sex development, without which it remains sterile, and gradually disintegrates. The infection, it is considered, is transmitted only through the bite of the host.

Transmission by Mosquitos.—A species of mosquito, a variety of the *anopheles*, acts as the intermediary host to the malarial parasite (*plasmodium* or *hematozoön malariæ*), and the disease is transmitted by its bite. A second mosquito, *ædes calopus*, formerly classed as the *stegomyia*, is considered in the same way to transmit the infection of yellow fever, and investigation at the present day points to the tsetse-fly as the carrier of the tropical disease known as sleeping-sickness. Bubonic plague is due to transfer of infection by fleas, and typhus fever is carried by body lice. Certain flies and cattle-tick are similarly the source of certain diseases affecting animals.

Size.—The microscopic minuteness of the above or-

ganisms is difficult to realize. To measure them, a special measure, the *micromillimeter*, or *micron*, is used, the symbol of which is the Greek letter μ. One micron equals the *thousandth part of a millimeter*, or $\frac{1}{25.000}$ *part of an inch.* Thus, if a bacillus measures in length one micron, 25,000, placed end to end, will measure only one inch. Some bacilli measure less than one micron.

CESTODES—NEMATODES

Other parasites which infest the human body are not protozoa, but may be briefly mentioned. Such are the *cestodes*, or tapeworms, and the *nematodes*, or roundworms, which gain entrance to the body through food or drinking-water containing the larvæ of these parasites. For the development of many of them an intermediary *host* is necessary, such as the hog, the ox, or fish. By these animals the eggs are ingested and the flesh becomes gradually infiltrated with the larvæ (measly meat). The larvæ consumed by man in such meat lodge in the intestine, and there develop into the different varieties of tapeworm. Another cestode has as its host the dog. The eggs gain entrance in drinking-water or on cress or other plants grown in the water and eaten raw, and develop in man, usually in the liver, where they grow and form numerous *cysts*, varying in size from a pin's head to a pigeon's egg (*hydatid cysts*).

Hookworm.—Among the nematodes are two important worms that cause serious illness when developed in man. One, the hookworm (*Ankylostomum duodenale*), develops in the small intestine. It is a small worm, about half an inch in length, with a hook-like head, by which it attaches itself to the walls of the small intestine. It causes an intense, persistent anemia, from which recovery is possible only if the worm can be expelled.

The **Filaria sanguinis hominis** is another which develops in the lymphatics. The embryos are found in the blood, it is said, only at night or during the hours of sleep. In time the worms cause occlusion of the lymphatics, and are the origin of a group of diseases arising from this condition, of which *elephantiasis* is one.

Both these worms are taken into the system in drinking-water. It is considered that the embryo of the filaria sanguinis hominis is taken from man to the water by the mosquito, another instance of an insect as a medium of infection.

Pin-worm.—Other varieties of nematodes are the pin-worm, common in children, the earth-worm, and the small worm peculiar to the hog, and found in "measly pork," which causes *trichiniasis* when developed in man.

EXAMINATION OF BACTERIA

Micro-organisms are examined under the microscope, both in a stained or an unstained condition (see below), and either alive or dead.

The Microscope.—The principal parts of the microscope are as follows (Fig. 141):

Eye-piece, or ocular.
Draw-tube.
Tube.
Objectives with nose-piece.
Stage.
Substage.
The coarse adjustment.
The fine adjustment.
Adjustment of substage.
The reflector.
The iris diaphragm.
The base.

The base supports a short pillar, to which the microscope proper is attached.

The ocular and the objective are both fitted with lenses, thus forming a *compound microscope;* a single magnifying lens is known as a *simple microscope.* Usually there are three objectives of different magnifying power, used at different distances from the object under examination. They are frequently named according to the focal distance. Thus, a $\frac{1}{2}$-inch objective is one focused half an inch above the object to be examined; the measurement has no reference to the size of the objective.

The terms *high power* and *low power* are employed to

denote the magnification, which depends both on the ocular and the objective.

The stage has an opening in the middle for the admission of light, directly over which is placed the specimen for examination on a glass slide.

Below the stage is the *iris diaphragm,* a circular shutter, by opening and closing which the area of light may be enlarged or decreased.

Where an intense illumination is desired, an arrangement of lenses known as the *Abbé condenser* is attached below the stage opening. The condenser focuses the light from the reflector, and throws an intense light on a small area. It is specially required when specimens are examined under the *oil-immersion lens.* The oil-immersion lens is used where a very high power of magnification is desired. The lower surface of a high-power objective ($\frac{1}{12}$) is immersed in a drop of cedar-wood oil placed on the cover-glass, below which is the object for examination. A layer of oil is then formed between the objective and the object. The oil prevents the dispersion of light, thus increasing the magnifying power of the microscope.

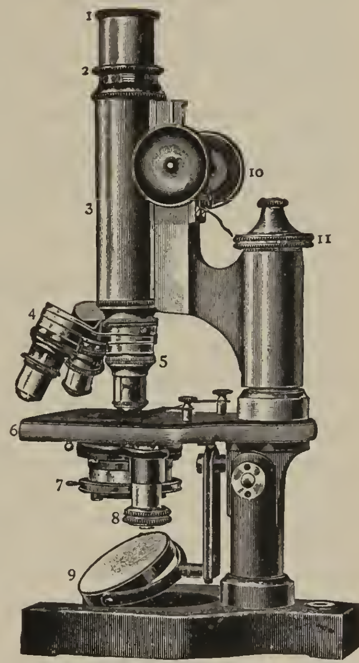


Fig. 141.—The microscope: 1, Eyepiece; 2, draw-tube; 3, main tube; 4, nose-piece with objectives attached; 5, objective in position; 6, stage; 7, substage; 8, adjustment of substage; 9, reflector; 10, coarse adjustment; 11, fine adjustment.

The object for examination in position, the objective is lowered close to the object, *without touching it,* by the coarse adjustment, and finally focused by the fine adjustment.

Before being shown specimens under the microscope, pupils should be carefully taught the simple manipulation of the different parts of a microscope and the purpose of each. Every part of a microscope is an expensive item, and more or less easily destroyed by careless handling, objectives in particular being readily spoilt by scratching.

Examining Bacteria.—For examining bacteria when alive, what is known as the *hanging drop* is used; for dead bacteria, the *smear.*

PREPARATION OF SPECIMENS FOR EXAMINATION

Smears.—In lifting the material for examination a fine platinum wire is used, mounted on a glass rod or on a special metal holder. The wire may be straight, or, more frequently, the end is twisted into a small loop. The wire is sterilized by being brought to a red heat over a clean flame (alcohol lamp or Bunsen burner), and must then be allowed to cool before using. After use the wire must again be sterilized in the same manner, in order completely to destroy any organic substances still adhering.

The specimen for examination is spread in a thin *smear,* in the center of a glass *slide,* a thin piece of clear glass about three inches long and one inch wide. The glass must be absolutely clean and free from scratches. If the specimen is thick and tenacious, it may be diluted by placing first a drop of distilled water on the slide. The smear is exposed to the air for a few moments to allow it to dry; it is then "*fixed,*" usually by passing the slide three times slowly through a clean flame. The smear is then ready for *staining.* The smear may also be made on a cover-glass, but this method is more difficult and less practical than the use of the slide.

Staining.—Weigert and Ehrlich, two German scientists, introduced, about 1877, a method by which micro-organisms in prepared specimens can be stained or colored, with-

out, at the same time, coloring the medium in which the bacteria are found. Certain colors derived from coal-tar products, and known loosely as anilin dyes, have, they demonstrated, an affinity for bacteria and for the nuclei of tissues. Bacteria stained by their dyes stand out clearly from the background, and are much more readily examined than are the transparent, colorless, ill-defined bodies they appear under the microscope in an unstained condition. Other anilin dyes, again, have no affinity for bacteria, but stain tissue diffusely, and serve, therefore, as contrast stains. The anilin dyes in use in bacteriology are classified as—(*a*) *acid* and (*b*) *basic* stains. The basic stains are used to stain bacteria and the nuclei of tissue; the most commonly used are fuchsin, gentian-violet, and methylene-blue. The acid stains are used chiefly to stain tissue-cells and as contrast stains; the principal are eosin and picric acid.

There are numerous methods of staining specimens. The following is one of the simplest:

1. Fill a small shallow dish with a weak solution of one of the basic dyes in distilled water.

2. Immerse the slide on which the smear has been made as above for thirty seconds.

3. Remove and wash thoroughly in distilled water, or, place a few drops of the stain directly on the smear; after thirty seconds to two minutes, wash. The specimen may now be examined under the microscope or it may be *mounted* permanently. To mount a specimen, a drop of Canada balsam is allowed to fall in the center of the smear; a cover-glass is then placed over the smear on the slide, and the two are gently pressed together.

Precautions.—In teaching pupil nurses a simple process of staining, the need for care in handling the specimens must be constantly emphasized. The cover-glasses and slides must be handled throughout with forceps; the loop must be sterilized by bringing to red heat *immediately* after use and *before being laid down;* the hands should be washed and disinfected when the process is over, in case, through inexperienced handling, any bacteria should accidentally adhere to the hands.

No one should touch a specimen in preparation, however carefully, if there is the smallest scratch or abrasion uncovered on the hands.

Many differential methods of staining are also used, the most important of which are Gram's method and the Ziehl-Neelson method of staining acid-fast bacteria, such as the tubercle and leprosy bacilli.

Ziehl-Neelson stain for acid-fast bacilli.

Required:

Carbol-fuchsin solution:

Basic fuchsin	1 gm.
Carbolic acid, pure	5 c.c.
Alcohol	10 c.c.
Water	100 c.c.

Nitric acid, 30 per cent., or sulphuric acid, 15 per cent., or acid alcohol (2 per cent. hydrochloric acid in 95 per cent. alcohol).

Löffler's methylene blue:

Saturated alcoholic solution of methylene-blue	30 c.c.
Caustic potash (0.01 per cent. solution)	100 c.c.

The smear being made as described:

1. Cover with the carbol fuchsin solution.
2. Hold the slide over a flame for a few minutes at such a distance that steam is formed.
3. Decolorize with either the nitric or sulphuric acid.
4. Wash in water.
5. Counterstain with methylene-blue.
6. Wash in water, dry, and mount in Canada balsam.

The tubercle bacilli will appear as "red rods in a blue field."

The method of thus demonstrating tubercle bacilli (Plate V) rests on the principle that "after adding to solutions of anilin dyes certain substances, such as carbolic acid, . . . the tuberculosis bacillus is stained with great intensity and gives up its stain with difficulty. Solutions of acids will remove the stain from all parts of the preparation except from the tuberculosis bacilli, which retain the dye. having once acquired it" ("Manual of Bacteriology," H. U. Williams).

PLATE V

Tubercle bacilli in urinary sediment; × 800 (Ogden).

Gram's Stain.—To 10 c.c. of distilled water in a test-tube add anilin oil to make a dilution of about 1 : 20. Shake thoroughly and filter. Add saturated alcoholic solution of gentian violet until the mixture is no longer transparent and a metallic film appears on the surface.

1. Cover the smear on the slide with this solution for three minutes.
2. Wash with water.
3. Cover with Gram's iodin solution three minutes.

Gram's iodin solution:

Iodin	1 gm.
Potassium iodid	2 gm.
Distilled water	300 c.c.

4. Decolorize with 95 per cent. alcohol until no more of the stain can be washed out.
5. Wash with water.
6. Counterstain with dilute carbol-fuchsin or Bismarck brown.

Gram-positive bacteria are those which retain the gentian violet.

Gram-negative bacteria are those that lose the gentian violet and take the counterstain.

The Hanging Drop.—When it is desirable to examine living bacteria, a special slide is used which has a small cell or depression in the center, ground out of the thickness of the glass. For such an examination the bacteria must be in a fluid medium. If the medium is solid, the culture is suspended in a drop of bouillon or sterile distilled water. The drop for examination is placed on a cover-glass, which is then laid, drop side downward, exactly over the small concavity, thus forming a tiny sealed chamber. Vaselin smeared on the slide round the edge of the depression serves to keep the cover-glass in place and to exclude air. In this *hanging drop*, as it is called, the movements of bacteria, their development and multiplication, can be observed under the microscope.

One of the important phenomena studied by the *hanging drop* is the so-called Widal or serum reaction of the typhoid bacillus (p. 384).

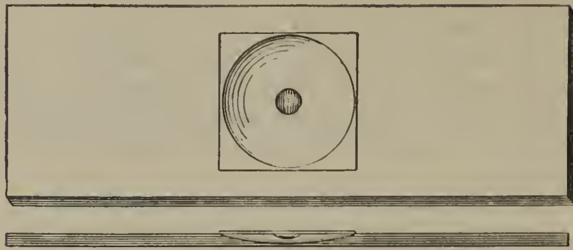


Fig. 142.—The "hanging drop" seen from above and in profile (McFarland).

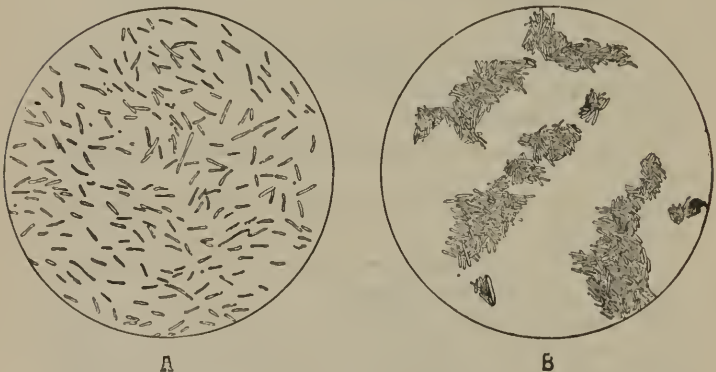


Fig. 143.—Application of the serum-reaction to typhoid bacilli: A shows the distribution of the bacilli before the reaction; B shows clumping of the motionless bacilli after mixture with the serum of a case of typhoid fever (Williams). (Diagrammatic.)

CULTURE OF BACTERIA

In order to study bacteria, it was found necessary to separate the different varieties, not only from each other, but from all other organic matter (matter, that is, of cell construction), and to cultivate them artificially by placing them in media that furnish the proper conditions for their development.

Culture-media.—The first culture-media were fluids, broths made from meat or vegetables, and contained in glass flasks. As media they were, however, imperfect;

all forms of microscopic life spread quickly through the fluid and were difficult to isolate or differentiate. By boiling the broths before introducing the material under examination a good deal of micro-organismic life was eliminated, and examination was further facilitated by *dilution* through several flasks of carefully prepared and sterilized bouillon. Thus the material from which the bacteria were to be cultivated would be stirred into one flask, a small amount would then be taken from the first flask and introduced into a second, and the process repeated through several others. The highly diluted specimen thus obtained was, when developed, much easier to examine than one crowded with micro-organisms. Still the method was baffling and imperfect.

In 1881 Koch, a German scientist, and, after Louis Pasteur, probably the most universally famous of bac-

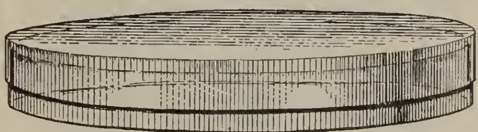


Fig. 144.—Petri dish for making plate cultures (McFarland).

teriologists, introduced the method known as *plating* and the employment of *solid* culture-media, which he obtained by mixing the bouillon with gelatin. Koch had observed that micro-organisms growing on solid bodies, such as the potato, grew in separate colonies, and did not become confluent, as when developed in fluid media. In plating, three tubes of gelatin-bouillon or agar are used, at a temperature which will keep the medium liquid. The infected matter is introduced into the first tube on a sterile *loop*. Three loopfuls are then taken from the first tube and mixed with the second, and three again from the second to the third. Each tubeful is then poured into a separate flat glass dish, called a *Petri dish*, and covered with a closely fitted glass cover. On cooling, the medium solidifies and serves to keep the bacteria stationary and separate from one another. As the bacteria develop, which

they do in from one to two days, each organism develops its own species in an area more or less isolated, forming what is known as a *colony*. In the third and most highly diluted specimen the colonies are fewer and more isolated than in the other two. A culture obtained in this way is known as a *pure culture*, of which the definition is that it is "one variety of one organism."

A pure culture may also be obtained by means of streaked plates. In this method the melted medium

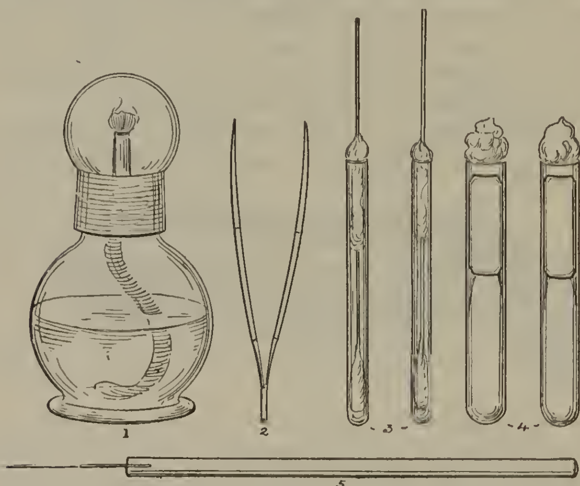


Fig. 145.—Instruments for making a culture: 1, Alcohol lamp; 2, thumb forceps; 3, sterile swabs; 4, culture-tubes; 5, platinum needle (Morrow).

(agar) is poured into a sterile Petri dish and allowed to harden. The material to be examined is then streaked over the surface of the medium by means of a sterile platinum wire or a bent glass rod. Two or more plates are inoculated without sterilizing the wire. Single colonies will develop as on the poured plates.

The advantage gained in examining bacteria developed by the plating method is obvious: its introduction gave an immense impetus to the study of bacteria, and especially to the discovery of the specific organisms which now

were quickly coming to be recognized as the cause of different diseases. Simple and practical though these modifications of existing methods by Koch appear, they are considered by bacteriologists to have had such important results that Koch is usually considered, by this invention, to have made the most important of any one contribution to bacteriologic research.

At the present day a variety of culture-media is used in the development of bacteria. *Nutrient bouillon* is the

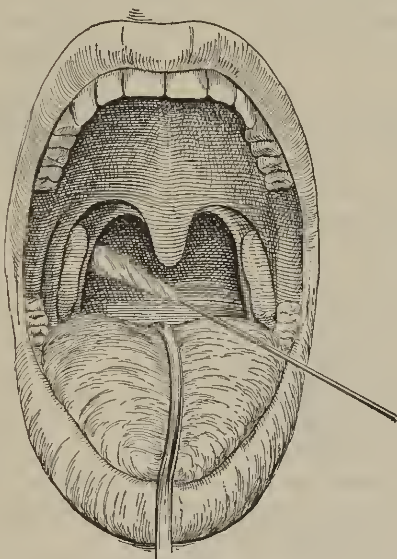


Fig. 146.—Showing the method of taking a culture from the pharynx (Morrow).

most commonly used, either by itself or as a basis for other culture-media. It is made of freshly expressed beef-juice or of beef-extract, to either of which are added peptone, common salt, and a proportion of water adjusted to a neutral reaction and sterilized. For the solid media the same bouillon is used, with the addition of gelatin or *agar-agar*. The latter is a jelly-like sea-weed obtained from Japan. It is valuable in laboratory work, as it

liquefies at a higher temperature than ordinary gelatin. Slices of *raw potato* are also used as solid culture-media. *Milk*, to which a small proportion of litmus is added, and *blood-serum* are other culture-media in frequent use.

"*Löffler's blood-serum*" is made of three parts blood-serum and one of a bouillon containing 1 per cent. glucose. It is the culture-medium usually employed to develop the diphtheria bacillus.

Blood-agar is made by adding a small amount of sterile blood to plain agar. This is used for the cultivation of organisms that do not grow readily on plain media, for example, the streptococcus, influenza bacillus, pneumococcus.

Various sugar media (glucose, lactose, saccharose, and inulin) are made by adding 1 per cent. of the sugar to the plain agar or bouillon. These media are used for the production of acid and gas by bacteria.

Many modifications of the above are used. All require the most careful preparation and sterilization in order to prevent the possibility of bacterial contamination. In their preparation the possibility of spore contamination must be borne in mind, since if these resistant bodies should develop, the media would be spoiled. To prevent this risk in the preparation of culture-media, sterilization is usually done by the fractional method (p. 428).

Taking a Culture.—It is frequently a nurse's duty to "take a culture," as, for example, from a patch on the throat or the discharging surface of a wound. For the process, the following are required:

A *loop*, or tooth-pick applicator mounted in cotton.

An alcohol lamp.

Two test-tubes containing the media desired. The test-tubes are stoppered with sterile cotton. The loop must be sterilized as described and cooled before using; if an applicator is used, it must, of course, be strictly sterile.

Taking the greatest care to come in contact with no other object, the loop or applicator is gently touched to the infected spot and lightly moved over the surface; the tube containing the medium is then opened, and the ma-

terial introduced. If a fluid culture-medium is used, the instrument is stirred into the fluid. When the medium is solid, about a third of the tube is filled in such a manner as to form a long, slanting surface; over this surface the instrument is lightly zigzagged from the bottom up, taking care not to break the surface. The cotton stopper, which must be held in the fingers and kept from touching any object, is then set alight at the alcohol flame, allowed to blaze a moment, and replaced. The loop is sterilized

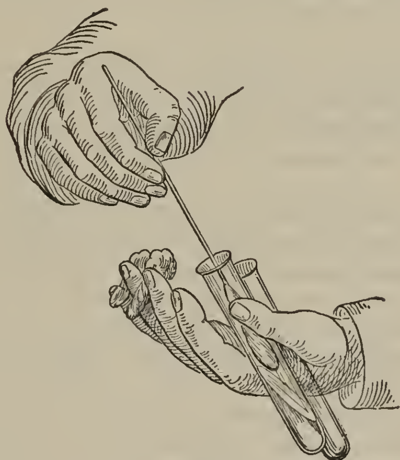


Fig. 147.—The method of making a smear culture (Morrow).

by reheating; a wooden applicator should be burned at once.

INFECTION

Pathogenic bacteria gain entrance to the body through the *lungs*, the *alimentary system*, the *genito-urinary tract*, or the *broken surface* of the skin or mucous membrane.

When they gain entrance to the body in sufficient strength to overcome the natural resistance of the body cells symptoms of disease result, and we say that *infection* has taken place. Infection may be *local*, as in an abscess or infected wound, or *systemic*, as in any of the so-called infectious diseases.

The bacteria themselves do not attack and destroy the tissues, but, as a result of their activity, they elaborate certain poisonous substances loosely classed as toxins. The production of these toxins is similar to the production of ferments in such familiar processes as the souring of milk, the fermentation of sugar, etc.

Bacterial toxins are of two kinds:

1. *Exotoxins*, or extracellular toxins, are poisonous substances produced and excreted by bacteria both in living tissues and in artificial culture-media. By the process of immunization an antitoxin can be produced against an exotoxin.

2. *Endotoxins*, or intracellular toxins, are not excreted by the bacteria, but are held within the bacterial cell and can be separated only by the breaking up of the cell body. Satisfactory antitoxins for endotoxins are not readily produced.

Ptomain.—An alkaloid substance produced by the action of bacteria on dead organic material, such as oysters, canned meats, milk, etc. Ptomains are usually elaborated during putrefaction, and are, in consequence, sometimes known as *putrefactive alkaloids*.

Contagious Diseases.—All diseases which are the result of bacterial invasion are, strictly speaking, *infectious;* that is, the specific disease does not develop unless the human being is actually infected with the specific germ causing this one disease. By the laity the term is generally loosely used to describe only such diseases as are communicable by either direct or indirect contact from man to man, which is misleading. The correct term for such diseases is *contagious*. While all contagious diseases are infectious, many infectious diseases are contagious only to a limited extent, as, for example, pneumonia, and others not at all, as, for example, rheumatic fever. Still another variety we have seen requires the intervention of an intermediary host to be conveyed from man to man.

Besides the general effects produced on the system, bacteria, as a rule, have an affinity for special organs or parts of an organ, in which they produce lesions charac-

teristic of the disease. Thus, in typhoid fever, we find certain glands in the lower intestine extensively ulcerated; in diphtheria, a characteristic membrane is observed, usually on the mucous membrane of the nose and throat; other infections are characterized by skin eruptions or *rashes*. The toxin produced by the tetanus bacillus acts on the nervous system, producing violent muscular contractions and profound prostration.

Some bacteria, such as the tubercle bacillus, attack now one group of body-cells, now another, producing in the process different groups of symptoms. Thus, when the germ attacks the coverings of the brain, we have tubercular meningitis with cerebral disturbances as the prominent symptom. If the same germ, however, attacks the lungs, we have pronounced pulmonary symptoms, while the brain may remain clear and undisturbed.

That certain diseases were from the earliest times recognized as contagious we know from writings that have come to us from the ancients. They also recognized that the spread of such infections was to some extent controlled by isolation and by purification of the effects and dwellings of the victims by fire and by cleansing with water. In such an ancient writing as the Odyssey we find reference also to the use of the fumes of sulphur for such purpose.

The discovery of the specific organisms that produce disease, with the manner of their invasion of the human structure, and the channels through which the invasion is effected, are the result of research covering but little more than the last half century. Of the many brilliant men to whom we are indebted for the numerous discoveries in the field of bacteriology, none is so famous as Louis Pasteur.

Louis Pasteur, a Frenchman, born in 1822, from about the year 1862 until his death in 1895 devoted his time, his money, and wonderfully brilliant intellect to bacterial research, especially in reference to the nature, course, and prevention of infectious diseases. His name is universally known as the originator of the method of curing *rabies* by inoculation. In the scientific world

Louis Pasteur is regarded, on account of the methods of observation he originated, his experiments, and the deductions and teaching he based upon the results obtained, as the father of all discoveries in the field of bacteriology; he is also the founder of the first school on the subject.

Theory of Antisepsis.—The discoveries of Pasteur and his school, especially on the nature and causes of fermentation and putrefaction, were followed with absorbing interest by the medical scientific world, but probably with but a faint conception of the enormous benefit to human and animal life which was to be the practical outcome of their work. In 1867 an English surgeon, Joseph Lister, then attached to Edinburgh University, and later to King's College Hospital, London, applying the teaching of Louis Pasteur to practical medicine, propounded the theory that suppuration in wounds was a process closely allied to fermentation, and similarly the result of the activity of micro-organisms which have gained access to the living tissues. If, therefore, he deduced, a wound could be protected from the invasion of bacteria (or *infection*), suppuration would not occur. From the basis of this deduction has been built up the entire fabric of modern antiseptic and aseptic methods in surgery, which have opened out to the surgeon the immense field of enterprise impossible before. A few years later (1872) a German scientist, Klebs, pointed out a similar origin as the cause of general sepsis, or blood-poisoning (which, up to this time, was constantly present in surgical wards), and a similar possibility of its prevention.

Koch's Postulates.—In the earlier years, as has been already noted, the imperfection of the means and methods of examination stood in the way of the discovery, differentiation, and classification of the various organisms. After the introduction of the methods of plating and staining already described, and with the improvements of the microscopic lenses, research began to make rapid strides, and many of the specific organisms of special diseases were discovered. In order that a specific organism should be recognized as the sole origin of a disease, Koch, the German scientist already mentioned, formulated certain

Diseases.	Germ.	Discoverer.	Nationality.	Date.
Anthrax	Bacillus of anthrax	Pollender	German	1849
		Rayer	French	1850
		Davaine	French	1850
Relapsing fever	Spirochæta obermeieri	Obermeier	German	1873
Amebic dysentery	Ameba of dysentery	Losch	German	1875
Malaria	Plasmodium malariæ	Laveran	French	1880
Typhoid	Typhoid bacillus	Eberth and Koch	German	1880
Pneumonia	Diplococcus lanceolatus, Fränkel's pneumococcus	Fränkel	German	1880
Tuberculosis	Tubercle bacillus	Koch	German	1882
Glanders	Bacillus mallei	Löffler and Schutz	German	1882
Erysipelas	Streptococcus of erysipelas	Fehleiser	German	1883
Cholera	Spirillum choleræ or comma bacillus	Koch	German	1884
Diphtheria	Klebs-Löffler bacillus	Klebs and Löffler	German	1884
Tetanus	Tetanus bacillus	Nicolaier	German	1884
Malta fever	Micrococcus melitensis	Bruce	English	1887
Chancroid	Ducrey's bacillus	Ducrey	French	1889
Bubonic plague	Bacillus pestis	Yersin } working independently	French	1894
		Kitasato } working independently	Japanese	1894
Cerebrospinal meningitis	Diplococcus intracellularis meningitidis	Weichselbaum	German	1887
		Jaeger (confirmed)	German	1895
Dysentery	Shiga's bacillus	Shiga	Japanese	1898
Sleeping sickness	Trypanosoma gambiense, Dutton	Dutton	English	1902
Syphilis	Treponema pallidum	Hoffman and Schaudinn	German	1905
Yaws (frambesia)	Treponema pertenue	Castellani	Italian	1906

rules or *postulates* with which, it was held, the microorganism must strictly comply:

1. The organism must be present in the tissues in every case of the disease, and in no other, and it must be found in sufficient numbers to explain the lesions of the disease.

2. The organism taken from such a case must be developed in "*pure culture.*"

3. The organism developed in pure culture must, when inoculated in a healthy animal, produce the same disease.

4. The same organism must be recovered from the animal so inoculated in which the disease has been reproduced.

Bacteria which have fulfiled these conditions are considered as the origin of the special disease in which they are found. At the present time, however, immunological reaction can afford proof of the specificity of a certain organism to a certain disease even though all of Koch's laws have not been complied with. The organisms shown on p. 377 have been proved to comply with Koch's postulates.

Another group of diseases are shown to be always assciated with a specific organism which is considered to cause the disease; these organisms fail, however, to comply with Koch's postulates. Such are:

Actinomycosis,	Relapsing fever,
Gonorrhea,	Whooping-cough,
Leprosy,	Yaws.
Rabies,	

and many tropical diseases. In many cases the bacteria fail to develop in the body of an animal.

In several other diseases, presumably due to microorganic invasion and classed as infectious, the specific bacteria have not yet been isolated. Such are:

Chicken-pox,	Mumps,
Epidemic poliomyelitis,	Scarlet fever,
German measles,	Smallpox,
Influenza,	Typhus fever,
Measles,	Yellow fever.

The majority of these diseases are actively contagious.

Many theories are advanced to explain why the bacteria of these diseases have so far baffled research. It is

suggested that the methods and means are yet imperfect, that the organisms may be too minute to be detected, even by the powerful lenses of the present day, or that the usual processes of culture, staining, etc., may actually destroy or render them invisible; others advance that the organisms may actually be dissolved by the products of their own activity.

A DESCRIPTION OF THE MORE COMMON PATHOGENIC BACTERIA

Cocci

Staphylococci are small Gram-positive, aërobic cocci that occur usually in irregular masses. They grow readily on all ordinary culture-media, producing a heavy and shiny growth. The pathogenic staphylococci are of three varieties:

1. *Staphylococcus* (*pyogenes*) *aureus*—most frequently found in acute suppurative conditions, such as abscesses, boils, and carbuncles. It is characterized by the golden yellow pigment produced by its growth on culture-media and is the most virulent of the three varieties.

2. *Staphylococcus* (*pyogenes*) *albus* — morphologically identical with staphylococus aureus, but produces no pigment. Cultures on agar have a milk-white color. One variety of the albus, the staphylococcus epidermidas albus, is constantly found in the epidermis. Usually innocuous, it may be the cause of suppuration in certain conditions, especially, it is said, when the tissues are irritated by the presence of a foreign body, such as stitches, necrosed tissue, etc.

3. *Staphylococcus* (*pyogenes*) *citreus* is characterized by the lemon-yellow pigment it produces. It is occasionally found in acute abscesses with other pyogenic cocci.

Streptococci are Gram-positive, aërobic, chain-forming cocci. They do not grow readily on ordinary culture-media, blood-serum or blood-agar being the most favorable solid media and ascites or serum bouillon the best fluid media for their cultivation.

Pathogenic streptococci are subdivided as:

1. *Hemolytic*—those which produce hemolysis of blood-cells and a clear zone around each colony on blood-agar. This is the most virulent type and includes the streptococcus pyogenes, responsible for acute abscesses, septicemia, puerperal fever, sore throat, and acute inflammatory conditions of the serous membranes, such as peritonitis, pericarditis, etc. The streptococcus of erysipelas also belongs to the hemolytic streptococci.

2. *Non-hemolytic*—those which produce no hemolysis of blood-cells and no clear zone around the colonies on blood-agar. This type is not so highly virulent as the hemolytic type, but may produce chronic inflammations.

Diplococci.—Of these there are several pathogenic forms:

1. *Pneumococcus* (*Diplococcus pneumoniæ*).—Oval or lancet-shaped coccus, usually in pairs, occasionally in short chains, Gram-positive, non-motile, and surrounded by a capsule when found in blood, sputum, or body fluids. Capsule formation is lost on artificial media. The pneumococcus does not grow well on ordinary media, blood-serum or ascites broth or blood agar being the best media for its growth.

Diseases caused by the pneumococcus are lobar- and bronchopneumonia, pleurisy, empyema, otitis media, meningitis, endocarditis, arthritis, tonsillitis, and conjunctivitis.

Pneumococci are divided into four types. Specific sera are produced for Types I, II, and III. All not classed as such are Type IV. In order to determine the type a portion of the sputum containing pneumococci is injected into the peritoneal cavity of a white mouse. The pneumococci multiply rapidly; other organisms die. Within six or eight hours the mouse becomes sick and usually dies. If it does not die it is killed and autopsied. The peritoneal exudate is washed out with sterile salt solution and centrifuged to throw down the bacteria. The bacterial sediment is then suspended in salt solution, portions of it placed in small tubes mixed with equal amounts of Type I, II, and III sera respectively. Agglutination or clumping of the organisms is produced by the specific

serum for their type. For example, if agglutination occurs with Type I serum and not with the other sera, the organism belongs to Type I.

Type sera are used in the treatment of pneumonia.

2. *Gonococcus* (*Micrococcus gonorrheæ*).—A Gram-negative diplococcus with a characteristic coffee-bean shape, the flattened surfaces facing one another. It does not grow on plain media—blood, ascites, or hydrocele agar being required for its cultivation.

The organism is frequently spoken of as *Neisser's organism* because it was discovered by Neisser. It is the cause of gonorrhea and gonorrheal ophthalmia and is found in the urethral and vaginal discharges and in pus from the infected eye. During the acute stage of the disease when the discharge is purulent the organisms are found almost entirely in the pus-cells.

Another method of diagnosis is by the *complement-fixation* test. This is of more value in chronic infections than in acute cases.

Gonorrheal ophthalmia is a frequent accidental infection at birth and is often the cause of blindness in infants.

3. *Meningococcus* (*Diplococcus intracellularis meningitidis*).—A Gram-negative coccus, usually found in pairs and closely resembling the gonococcus. The organism does not grow on ordinary media, blood-serum or ascites or blood-agar being the best media for its growth.

The meningococcus is the most frequent cause of purulent meningitis (rare cases are caused by pneumococci, streptococci, and the tubercle and influenza bacilli). It is frequently found in the nasal cavities and from there finds its way to the meninges. It can be found in the spinal fluid of such cases, both within and without the cells of the fluid. If the organisms are intracellular the prognosis is better.

An antimeningococcus serum has been produced by immunizing horses with meningococci. In the treatment of meningitis the serum is injected intraspinally. Under this treatment the mortality has been reduced to about 25 per cent. as compared with a mortality of 50 to 80 per cent. without serum treatment.

Micrococcus catarrhalis is a Gram-negative diplococcus found in the mucous membranes of the respiratory tract. At times it may cause inflammation of the membranes and pneumonia. The organisms resemble meningococci and are sometimes confused with them. In this case cultural and serological tests must be made. Micrococcus catarrhalis grows readily on plain agar.

Bacilli

Anthrax Bacillus (*Bacillus anthracis*).—A long, slender bacillus, Gram-positive and non-motile. It grows readily on ordinary culture-media and is characterized by the formation of spores which are extremely resistant to heat and disinfectants. The organism can usually be found in a direct smear from the lesion, where it appears as a single encapsulated bacillus. In culture it produces long, fine chains or filaments composed of a number of organisms placed end to end.

The anthrax bacillus is the cause of anthrax, a disease prevalent among animals, especially sheep and cattle, and also occurring in man as a result of infection through the skin, alimentary canal, or lungs. It is found among persons who work with leather, hair, or wool, and the most common form, malignant pustule, is produced by infection through an abrasion of the skin on the face, neck, or arms.

Diphtheria bacillus (*Bacillus diphtheriæ*) is commonly known as the *Klebs-Löffler bacillus*. The organisms vary greatly in size and shape, grow singly or in pairs, and usually appear at angles to one another. The rods are sometimes straight, sometimes curved, and may contain one or more refractile bodies called *granules*. They are stained best by Löffler's methylene-blue, which stains the granules more deeply than the rest of the organism. Löffler's blood-serum is the best medium for the cultivation of diphtheria bacilli.

Some types of diphtheria bacilli are virulent, some non-virulent. The test for virulence is made by inoculating a 200-gram guinea-pig subcutaneously with a portion

of a twenty-four-hour pure culture. If the culture is virulent the pig dies within twenty-four to seventy-two hours or shows signs of toxemia or paralysis. On autopsy a hemorrhagic edema is seen at the point of inoculation and the adrenal glands are congested.

Vincent's bacillus (*Bacillus fusiformis*) together with spirochetes is the cause of *Vincent's angina*, a pseudomembranous condition of the throat sometimes confused with diphtheria. The organism is detected in direct smears from the throat, stained with dilute carbol-fuchsin. It appears as a large crescent or "banana-shaped" organism, pointed at each end, and containing one or more heavily stained granules. The spirochetes associated with Vincent's bacillus are very fine, thread-like organisms usually showing a number of spirals.

The Colon Typhoid Group of Bacilli.—Among the most important members of this group are:

The typhoid bacillus (*B. typhosus*).

The colon bacillus (*B. coli*).

The dysentery bacillus (*B. dysenteriæ*).

The paratyphoid bacilli A and B (*B. paratyphosus* A and B).

The chief characteristics common to all are: (1) Similar morphology—short, plump, non-spore-bearing bacilli; (2) Gram-negative staining reaction; (3) similar growth on agar and gelatin; (4) non-liquefaction of gelatin.

The *colon bacillus* is a normal inhabitant of the intestines, but may at times become pathogenic by infecting the gall-bladder or urinary tract or by producing peritonitis in typhoid fever. It is of interest also because it is an index of fecal pollution, a very important factor in the examination of water.

The colon bacillus differs from the typhoid bacillus in that it produces acid and gas in glucose media, forms red colonies on Endo medium, and gives a negative Widal reaction with typhoid serum.

The *typhoid bacillus* does not produce acid and gas in glucose media; it forms colorless colonies on Endo medium and gives a positive Widal reaction.

The *Widal reaction* is used in the diagnosis of typhoid

fever and is due to the presence of antibodies or agglutinins in the blood of a patient having typhoid fever. These agglutinins have the ability to agglutinate typhoid bacilli or cause them to form in clumps.

Technic of the Widal Reaction.—A small amount of blood is obtained by pricking the finger or ear of the patient and collecting a few drops of blood in a small tube. The clot is broken up and centrifuged and the serum separated and diluted 1 to 10, 1 to 20, and 1 to 40 with salt solution. Hanging-drop preparations (p. 367) are made with each of these dilutions, one loopful of diluted serum being mixed with one loopful of an eighteen-hour broth culture of the typhoid bacillus. This gives final dilutions of 1 to 20, 1 to 40, and 1 to 80.

A culture control is also set up with one loopful of the broth culture and one loopful of salt solution. Preparations are allowed to stand at room temperature for one hour, then examined microscopically. Loss of motility and clumping of the bacilli in the lowest or in all of the dilutions, with no loss of motility or agglutination in the culture control, constitutes a positive reaction.

The serum of a patient does not give a positive reaction until a week or more after the onset of the disease, but retains it for a year or more after recovery. Persons who have received typhoid vaccine also give a positive Widal reaction.

Influenza Bacillus (*Bacillus influenzæ; Pfeiffer's bacillus*), a very small, thick, Gram-negative, and non-spore-bearing bacillus which occurs singly or in pairs. It does not grow on ordinary culture-media, but requires a medium containing hemoglobin. Blood-agar is the best medium for its cultivation..

While it has been proved that the influenza bacillus is definitely pathogenic, its specificity in epidemic influenza has never been proved and it may be only a secondary invader.

Bacillus pyocyaneus—a small, slender bacillus, Gram-negative, and occurring frequently in pairs or in chains of four or six. It grows well on all ordinary culture-media and is characterized by the formation of a green color

in the medium. The blue and green coloration often noticed in pus is due to this organism, which is ordinarily non-pathogenic, but in cases of debility may become a source of infection.

Tubercle Bacillus (*Bacillus tuberculosis*), a small, slender, non-motile rod, sometimes curved and sometimes having a beaded appearance. It is an acid-fast organism and does not grow on ordinary culture-media. Coagulated serum or egg-media, glycerin-agar, and potato may be used for its cultivation.

The organisms can be found in the sputum from pulmonary tuberculosis, in urine and feces, in many of the internal organs and glands, in the joints, bones, mucous membranes and skin, and in the spinal fluid from tubercular meningitis. In cases where the tubercle bacilli cannot be detected by microscopic examination a small amount of the suspected material may be injected subcutaneously into a guinea-pig in the region of the inguinal gland. After about four weeks the pig is killed and autopsied. Even a very small number of tubercle bacilli will produce tuberculosis. On autopsy the animal shows marked swelling of the inguinal gland and tubercles on many of the internal organs, especially the liver and spleen. The bacilli may be recovered from the tubercles.

Leprosy Bacillus (*Bacillus lepræ*), an acid-fast bacillus resembling the tubercle bacillus. It has never been definitely proved that the organism can be cultivated on artificial media and the disease has never been produced experimentally in animals. The bacilli can be demonstrated in tissues (skin, internal organs, and nerves) and in the secretions of the mucous membranes of the mouth and nose, as well as in direct smears from the lesions.

Tetanus Bacillus (*Bacillus tetani*), a slender, motile, Gram-positive bacillus with rounded ends. Spores are formed in the bacillus which develop at one end of the organism and distend it, giving the characteristic "tack" or "drum-stick" appearance. The organism can be cultivated on ordinary media if grown anaërobically.

Tetanus is caused by the entrance of the bacillus into a wound or through an abrasion of the skin. A toxin is

produced which attacks the central nervous system, thus causing the spasmodic contractions of the muscles and the paralysis, which are characteristic of the disease.

Spirilla

Cholera spirillum (*cholera vibrio*, "comma bacillus")—a curved rod with rounded ends. The curvature may be very slight, like that of a comma, or distinctly marked. The organism is Gram-negative and can be grown readily on all ordinary culture-media. It is found only in the intestines in cases of Asiatic cholera, where the symptoms of the disease are produced by a toxin which is released by the breaking down of old organisms.

Pathogenic Protozoa

The most important of the pathogenic protozoa are the *trypanosome* of sleeping sickness, the *spirochetes* of syphilis and yaws, and the *plasmodium* or *hemameba* of malaria. These organisms belong to the animal kingdom and are more complex in structure than the bacteria.

The trypanosome of sleeping sickness (*Trypanosoma gambiense*) is a long spirally twisted organism along one side of which is attached an undulating membrane with a cord-like edge that is continued forward as a free flagellum. It is actively motile and may be seen moving among the corpuscles in a fresh drop of blood from the patient.

The **spirochete of syphilis** (*Spirocheta pallida* or *Treponema pallidum*)—a delicate, thread-like organism, having from three to twenty spirals. It is flexible and actively motile. It does not stain well with bacterial stains, special staining methods being required. When alive it cannot be seen readily with the ordinary microscope, but must be studied by means of a special microscope with a dark-field illumination.

The **malarial parasite** (*Plasmodium* or *Hemameba malariæ*) on account of its complex life-cycle may show a number of different forms, the most common form, however, being the ring body. In a stained preparation

the parasite may be seen lying on a red blood-corpuscle. When properly stained it appears as a disk consisting of a central, unstained area with a blue periphery, at one side of which is a rounded, compact, red mass, which gives the parasite the form of a signet ring.

MODES OF TRANSMISSION

The germs of disease are conveyed to man, in the large majority of cases, by the air, or, more correctly, the dust-particles in the air, and by water or food contaminated by impure water. Other methods are by direct inoculation and by the bite of an insect acting as *host* to the germ.

Air-borne Diseases.—Diseases carried by floating dust are classed as air-borne. The majority invade the respiratory tract. In this class are all actively contagious diseases:

Cerebrospinal meningitis.
Chicken-pox.
Diphtheria.
Epidemic pneumonia.
Influenza.
German measles.
Measles.
Mumps.
Scarlet fever.
Smallpox.
Tuberculosis.

The germ-laden dust-particles may float in the air or may settle on solid articles in the vicinity of the patient, which may then become media of infection. Substances which absorb contagion in this way or by direct handling by the patients are called *fomites.* In the more virulent infections, especially smallpox and scarlet fever, the germs are retained by the fomites for practically indefinite periods. Articles actually handled by the patients, such as toys, books, and work, are impossible to disinfect with any certainty, and should be destroyed after convalescence or given for the use of patients suffering from the same disease in hospitals devoted to this purpose.

The germs may escape into the air in several ways.

The special germs causing the disease, it must be remembered, are always present in the greatest number in the lesions of the disease.

1. When lesions are present in any part of the respiratory tract, the *mouth, throat, nose,* or *lungs,* the germs are actually breathed into the air and adhere readily to floating dust. In such acts as sneezing, coughing, speaking, and even breathing, under some circumstances, the germ may be transmitted in minute drops of moisture which remains suspended in the air for considerable periods. Infection by this means is known as *droplet infection.* In the diseases above mentioned many are characterized by lesions in the throat or air-passages. In those without this special characterization, especially typhus fever, meningitis, and smallpox, the germ seems also to be present in the breath.

2. In those infectious diseases characterized by a rash and followed by *desquamation,* the germs are contained in the shed particles of epithelium. Minute particles remain floating as dust in the air or settle on objects in the vicinity, which then become sources of contagion.

3. Where the lesions of the disease are associated with abnormal *secretions,* countless numbers of the germs will be found present in the discharges, sputum, etc. As long as the bacteria remain enmeshed in the moist substance they are not in a position to do harm, and may readily be destroyed (see Disinfection). If, however, through lack of cleanliness, the discharges are allowed to dry, as, for example, the sputum in public streets, or on the hands, sputum-cups, or clothing of patients or attendants, the germs are set free and carried by floating dust.

Water-borne Diseases.—A more limited number of infectious diseases are communicated through drinking-water, contaminated by the specific bacteria of the disease, and are classed as *water-borne* diseases. They invade the system through the alimentary tract. Such are:

Cholera.

Diarrhea (certain forms).

Dysentery.

Typhoid fever.

Food may also be contaminated with the bacteria of any of these diseases by such means as washing vegetables consumed in a raw condition with contaminated water, by using such water for the cleansing of vessels, especially those for containing milk, or by diluting milk with contaminated water. Food may also be infected directly from the hands of patients or their attendants if these are not kept scrupulously clean, and the bacteria probably taken into the system in this way. Infection has also been conveyed by oysters that have been fed on a contaminated water supply. (Flies, p. 391.)

Water-borne diseases may also in certain conditions be air-borne.

The lesions in this class of infections are in the alimentary tract, consequently the evacuations are loaded with the bacteria. If the evacuations are left exposed and not immediately disinfected, the bacteria readily escape into the surrounding air and may be conveyed on floating dust. The smallest stain of feces on linen or vessel should be regarded as an active colony of bacteria and rigorously disinfected.

Some *air-borne* diseases may also be made *water-borne* by direct contagion. In this way scarlet fever and diphtheria have frequently been spread from a milk supply where the milk has been left exposed in the vicinity of such cases. Milk, it will be remembered, is one of the media in which bacteria readily grow.

Tuberculosis is conveyed in the milk or flesh of cattle with the animal variety of this disease. While the bovine type of tubercle bacillus infects human beings with difficulty, a number of cases on record have proved beyond question that there is danger, especially to children, when they are exposed to this source of infection.

A group of infections associated with surgical conditions are also *air-borne,* but invade the system through the *broken surface* of the skin or mucous membrane. Such are:

Erysipelas.
Puerperal fever.
Septicemia.
Pyemia.

All forms of septic infection, either general or local.

Instances also occur where the germs of scarlet fever, diphtheria, or smallpox apparently invade the system through the broken surface. This is demonstrated in the peculiar susceptibility of patients during the puerperium to these infections, and a disposition on the part of patients who have undergone recent operation to develop a mild form of scarlet fever. The diphtheria germ has also been known to attack the broken surface, developing the characteristic membrane on the surfaces of wounds, and giving rise, at the same time, to the physical symptoms that accompany an attack of diphtheria.

Infection by Inoculation.—Besides the air-borne diseases which invade the system through an accidental break in the continuity of the surface of the body at some point, others require that the virus containing the germ should be directly inoculated below the surface, as the snake, by its bite, introduces its venom into the blood.

The principal diseases of man so communicated are:

Cowpox, or vaccine.
Glanders.
Gonorrhea.
Leprosy.
Ophthalmia.
Rabies.
Syphilis.
Tetanus.

The germ of **tetanus** develops in the *absence* of air; it finds a favorable condition for development in the deep wounds caused by puncture or by gunshot accidents; it is especially to be guarded against in wounds that are contaminated by the soil, since the tetanus germ is found in the soil.

Rabies is introduced by the bite of an infected animal; **syphilis,** by the virus coming in direct contact with an abrased surface; **ophthalmia,** in like manner, through an abrasion of the conjunctiva; **leprosy, glanders,** and **cowpox,** the two latter diseases transmitted to man from cattle, are usually conveyed through abrasions on the hands. It is considered probable that **bubonic plague** also

invades the system by inoculation, as well as by the respiratory and alimentary tracts.

Tuberculosis, though most commonly conveyed by the air, either through floating dust or by droplet infection, may also be transmitted by inoculation. This is especially true of tuberculosis attacking the skin, as in lupus, and should be borne in mind in working with laboratory specimens.

As has already been noted, certain diseases are transmitted from man to man through the bite of an insect acting as intermediary host. Such are **malaria,** by the *anopheles mosquito;* **yellow fever,** by the *aëdes calopus;* **sleeping sickness,** by the tsetse fly; and **typhus fever,** by the body louse.

Recent investigation seems to show that bubonic plague is frequently transmitted by the bite of fleas infesting rats which are infected with the plague bacillus.

Relapsing fever, a disease fast disappearing under improved hygienic conditions, is also considered to be probably conveyed by the bite of an insect, and the same may be true of other infections which are spread by filth and overcrowding, such as typhus fever or jail fever. That domestic insects, flies, bedbugs, etc., may be carriers of disease is an accepted fact, and all methods of prophylaxis and disinfection include the rigorous extermination of these pests. Flies we can readily realize may be the means of infecting milk and other foods. We know how quickly they are attracted to organic matter. If, through lack of cleanliness, flies are allowed to alight on particles of feces, sputum, soiled dressings, and similar sources of infection, germs may adhere to the legs and bodies of these insects and be conveyed to food left exposed; in addition, fly spots are made by the excreta and the vomitus of these insects. The water-borne diseases, especially typhoid fever, are particularly apt to be spread in this way.

PROPHYLAXIS OF THE INFECTIOUS DISEASES

Modern prophylaxis, or the prevention of infectious diseases, rests on a recognition of the sources of infection, and on the use of hygienic and scientific methods for the control of the media by which infection is spread.

The most powerful enemies of the air-borne infections are fresh air and sunlight. The air of a sick-room, if well diluted with constantly changing fresh air, will obviously contain much fewer germs than if the room is kept closed and only "aired" at stated intervals. Direct sunlight is a natural germicide, and should have access to every corner of a sick-room. The walls, floors, and furniture of a room constantly used as a sick-room should be chosen with hard, non-absorbent surfaces and kept scrupulously free from dust; draperies, rugs, and upholstered furniture should be banished or be entirely of washable materials, as should also be the clothing of those in attendance on the sick. The air of the sick-room should be kept free from contamination from such sources as uncovered sputum-cups, soiled surgical dressings, or bed-pans not instantly removed.

The prophylaxis of the *water-borne* infections bears chiefly on the insistence of a pure water supply and the scrupulous disinfection of all excreta in these cases. (See Disinfection, p. 442.) If there is any doubt on the subject of the water-supply, it must be an absolute rule that only boiled water is used for drinking, for washing vegetables, and for cleansing the vessels used for cooking and in the serving of the meals. The water-supply of districts may be contaminated from infected excreta thrown without thorough disinfection down the soil-pipes, or from excreta deposited on the surface soil or carried to cess-pools in the vicinity of natural wells. Standing water, such as the water of wells, if once contaminated, always remains so, and the well must, therefore, be closed.

Food must obviously be screened from flies, and never exposed in the neighborhood of lavatories; milk and butter should be especially kept in closed cans or chests. The strictest care must be taken in the immediate cleansing of the hands after doing any service about the patient, and especially in regard to the removal and disinfection of the excreta. The vessels used should be closely covered for removal from the bedside, and the smallest stain of fecal matter on the linen disinfected at once.

Domestic insects, flies, mosquitoes (page 395), and

bedbugs should be literally exterminated as far as such means can be controlled by the hospital authorities. Adequate screening will rid a building of the menace of flies, but there are many conditions in which patients are not nursed in buildings, as in tuberculosis open-air camps and, notably, in the huge hospital camps of the late war. It is stated on reliable authority, as a remarkable triumph of modern hygienic methods, that a fly was practically unknown in the huge army medical camp at Etable, a camp where every unit took care of one thousand sick and wounded. This was accomplished chiefly by having nothing exposed that would attract flies. Excreta, garbage, grease, and all manner of refuse was promptly collected and destroyed by burning; grease from sinks and hoppers was collected systematically twice a day; slops and soapy water instead of being emptied on the ground were emptied into pits containing coke on large perforated trays; these acted as a filter, by means of which grease and other débris were caught and could be destroyed by burning, and the soil was thus prevented from becoming clogged and sour. The trays and pits were painted with crude petroleum as a further prevention of flies.

The superintendence of these details was one of the most important duties of the sanitary officer and his subordinates, and to their care is largely due the fact that for the first time in history a camp of wounded soldiers has been as sanitary and as free from epidemic disease as the best equipped hospitals in our cities.

In those air-borne diseases which invade the system through the broken surface (see above), protection lies in never exposing a wound where there is any possibility of these germs being present in the air. Such cases may be nursed without risk of contagion in a medical ward, but are a fertile source of infection in a surgical ward, where wounds are exposed for dressing or treatment.

The spread of infection where *inoculation* is the means of transmission should be easy to control; nevertheless, the sources of infection require to be recognized. Rabies is transmitted only by the bite of a rabid animal (unless one excepts accidental inoculation in laboratory work).

The germ of tetanus is found in the soil, especially in soil contaminated by the excreta of herbivorous animals, such as may be found round farms and stables. The germ is usually introduced at the time of injury, but wounds previously clean may absorb the tetanus germ if exposed to dirt in which the germ is present. The virus of syphilis is contained in any of the discharges of a syphilitic patient. Discharges from the genito-urinary tract or the nose, and ulcers with a discharging surface, are common manifestations of venereal disease. An abrasion on the hands of doctor or nurse carelessly brought in contact with such discharges may readily be the means of infecting the system with this most virulent disease. Closets and vessels used by patients with gonorrheal discharge are a source of infection unless rigorously disinfected. The virus may also be transmitted to a third person by the hands of the attendant or by instruments, especially catheters, laboratory vessels, or linen, which have been used for a syphilitic patient and imperfectly disinfected. Ophthalmia is communicated in a somewhat similar way. The discharge, in this instance, must come in contact with the conjunctiva. The eyelids may be rubbed with fingers contaminated with the discharge either directly or indirectly from handling infected instruments, towels, etc. A common channel for the spread of ophthalmia, especially in children's wards, is the apron-bibs of nurses who thoughtlessly take a baby with ophthalmia on the arm. The next baby taken in the same position runs a grave risk of infection.

The infection of wounds with pus-producing organisms (usually a variety of staphylococcus) is also to a large extent a process of inoculation. The channel is most commonly the hands of the operator or dresser, and, less frequently, the instruments, lotions, dressings, ligatures, etc., used. (See Surgical Technic, Chap. XIV.) A local abscess following the administration of a hypodermic injection, and an infected finger from contact of an unnoticed scratch with an infectious discharge, are direct examples of pus infection by inoculation.

It must also be remembered that germs not usually

transmitted by inoculation may also be introduced into the system in this way. Thus, a hypodermic needle, used, for example, on a diphtheria case and imperfectly sterilized, may inoculate with the diphtheria bacillus a second person not otherwise exposed to the contagion.

When we realize that in common with all other known forms of life a germ can only spring from a similar germ already existing, we can understand the immense importance of intelligent prophylaxis. A case of scarlet fever, for example, can no more occur independently than a field of wheat can be grown without seed. Infectious illnesses are already more under control than has ever been possible before, and pure air, sunlight, and pure water are regarded not as luxuries, but as necessary to all if the health of the community is to be maintained.

In the transmission of infections through an intermediary host prophylaxis lies in the protection of man from the bite of the insect and in the extermination of the insect.

The special insects at the present day known to be transmitters of the specific diseases are peculiar to certain districts. Persons who show a special liability to malaria should avoid the districts where the anopheles mosquito is known to exist. The dwellings in these localities should be carefully screened, and vigilance exerted that each insect that may gain admission is promptly destroyed. Persons should remain indoors during the feeding times of the mosquito, especially evening and early morning. When a person has become infected, he must be carefully protected from being bitten, since it is only from his blood that the mosquito in its turn becomes infected. In cases of yellow fever the patient is at once isolated in a fly-screened tent, a precaution which, as soon as adopted, reduces enormously the number of patients in an epidemic of this disease. The insects are exterminated by destroying their breeding-grounds; in the case of the malarial mosquito the breeding-ground is the stagnant water of swamps, woodland pools, etc., or, in inhabited districts, the barrels and cisterns in which water is collected. Thorough drainage in many districts, such as the fen countries of England, has been followed by total extermination

of the mosquito and complete disappearance of the disease. Pools and small areas of stagnant water are in other parts covered with coal-oil and thus made impossible as breeding-grounds. Wells, water-barrels, drinking-troughs, reservoirs, and all vessels containing standing water must be kept closely covered or in carefully screened inclosures.

IMMUNITY

All persons exposed to infection do not necessarily succumb to disease. This is due to two conditions—first, the natural *resistance* of the body; and, second, a condition of *immunity*, either *natural* or *acquired*.

It is considered that the chief elements of resistance to bacterial invasion are found in the blood: in those white corpuscles, or *phagocytes*, whose function it is to seize and destroy foreign bodies gaining access to the body, and in the blood-serum, which is also held to have bactericidal properties. Bacteria are also eliminated in the natural excreta of the body, especially in the evacuations of the bowel. A further protection is given to the body, it is considered, in the natural secretions which cleanse the surface and the external cavities of the body, ridding them, to some extent, of invading bacteria, and which, if not actively germicidal, form media in which bacteria do not readily develop; such are the sweat, the tears, the saliva, and the mucous membrane secretions. The hydrochloric acid contained in the gastric juice is also held to have germicidal properties toward the bacteria of the *water-borne* diseases.

Certain conditions weaken the natural resistance of the body and leave it a prey to infection. Such are unhygienic conditions, overwork, overstrain mental or physical, alcoholism, starving, exposure, debilitating or chronic diseases, such as kidney disease, diabetes, etc., local injuries, serious accidents, and other conditions that impair the general health.

In surgical work sound tissue is held to show considerably more resistance to bacterial invasion than tissue that has been injured by accident, or by rough handling during an operation.

At certain times the bacteria may be present in abnormal numbers, as during epidemics, and the natural resistance may be overthrown on this account.

Natural immunity is the unbroken resistance exhibited by a race or a species to certain diseases. Thus the negro is proved to be immune to yellow fever; the dog is immune to typhoid fever, the common infectious fevers, and other diseases of man, and man, on the other hand, to certain diseases of the lower animals.

Acquired immunity may be either *active* or *passive.*

By *active immunity* we mean an immunity that is the result of previous bacterial activity in the body of the patient.

This may be attained in three different ways:

1. By an attack of the disease.
2. By vaccination.
3. By certain forms of inoculation.

Passive immunity is brought about by the injection of *antitoxins.*

We know that if recovery is to take place from an infectious malady, at a certain point in the disease there comes a turning-point after which there are no fresh manifestations of bacterial activity. The symptoms of the disease subside, and in a short time convalescence follows. In some infections the turning-point is abrupt, and we say that the disease ends with a *crisis;* in others the improvement takes place more slowly, and we use the term *lysis.* In many diseases we can tell to within a few hours when the crisis will take place or the lysis begin. Not only is the further development of the disease arrested, but the body for a time is impervious to fresh infection from the same disease. Thus a patient just recovered from scarlet fever can mix freely with patients at the most contagious stage of that disease, without contracting the disease a second time. As regards scarlet fever, they are in a state of acquired immunity.

In many diseases the acquired immunity conferred by one attack lasts through life. Such are:

Chicken-pox.	Scarlet fever.
Epidemic poliomyelitis.	Typhoid fever.
German measles.	Typhus fever.
Mumps.	Yellow fever.

Second attacks of these infectious diseases are uncommon. Second attacks of measles and whooping-cough occur somewhat frequently, and in small-pox also second attacks are known. In typhoid fever second attacks do occasionally occur, but are not considered the rule; a form of reinfection during the early stage of convalescence is, however, frequently observed. An error of diet, or conditions that exhaust the vitality of the patient, such as exertion, are commonly the predisposing causes. To this form of reinfection the term *relapse* is applied.

In other infections the immunity conferred is only temporary, and one attack of the disease appears to predispose to repeated attacks. Such are:

Erysipelas.
Influenza.
Malaria.
Pneumonia.
Rheumatic fever.

Vaccination.—A very mild attack of a disease confers immunity as completely as a severe attack. This principle was for long applied practically in the East of Europe in the treatment of smallpox, a disease in its severe form frequently fatal. It was the custom to puncture the skin of persons likely to be exposed to smallpox infection and introduce in this way a drop of the smallpox virus. Patients thus inoculated developed a mild form of the disease, from which they usually recovered, and which apparently protected them from another attack. The custom attracted the interest of Lady Mary Wortley-Montague, the wife of the British Ambassador to Constantinople, and, through her, the attention of the scientific men of the day (about 1718). The method had the drawback, however, that the disease, though mild, was contagious.

Toward the end of the eighteenth century another English woman observed that during an epidemic of smallpox none of her dairy-maids fell sick. She found that they attributed their protection to the fact that they had all had cowpox (or vaccinia), which they had acquired from

the cows they tended through abrasions on the hands or arms. Inquiry showed that the belief that vaccinia protected from smallpox was general among the farming classes.

Edward Jenner, a noted London physician, conceived the idea of inoculating with the virus of cowpox instead of smallpox, thus producing the same immunity with a disease which had the advantage of being mild and non-contagious. To this form of inoculation he gave the name *vaccination.*

Jenner first practised vaccination in 1796. So great a success attended the practice that it rapidly became the customary means of protection against smallpox. Later, with the idea of stamping out effectually so dreaded and wide-spread a disease, it became law in many parts of the world that all infants should be vaccinated. Only in late years have the laws been relaxed.

The immunity to smallpox conferred by vaccination is not considered to last more than a few years, nor is the immunity always absolute. If the disease is contracted, however, after recent vaccination, it is in a mild form.

Technic.—The process of vaccination consists in superficially scarifying the skin with a sterile needle or fine knife, and rubbing over the surface a drop of lymph from a calf previously inoculated with vaccine. Cowpox vaccination produces few physical symptoms, its chief manifestation being a characteristic cowpox pustule at the seat of vaccination.

Inoculation.—The system of *inoculation* originated by Louis Pasteur, by which work he is most widely known, consists in injecting what he calls an "*attenuated virus,*" that is, a poison highly diluted, into the blood, with the effect that an extremely mild form of the disease is developed, which yet is sufficient to confer immunity. The Pasteur school employs many different methods of obtaining this *attenuation,* some of them very complicated. Pasteur's method of inoculation is universally used as a preventive of hydrophobia in persons who have been bitten by rabid animals. It is also used in some other diseases of animals. (See also page 399.)

Tuberculin.—In 1892 Koch introduced inoculation in the treatment of tuberculosis, using *tuberculin*, a heated 50 per cent. glycerin solution of the product of the tubercle bacillus in culture fluid and such portions of the bacillus as go into solution. On persons that are free from tuberculosis no effect is produced; on others both a local reaction and pronounced physical symptoms develop. At first immense hopes were raised that a cure for tuberculosis had been discovered. Its use, however, was soon found to be attended with danger to the patient, and it was abandoned as a method of treatment. It is at present used on cattle and pigs for purposes of diagnosis in those parts of the world where the law requires that animals to be used as food should be destroyed if proved tuberculous.

Skin Tests for Foreign Proteins.—These tests are similar to the tuberculin diagnostic test. Many persons show an idiosyncrasy or hypersensitiveness to various protein substances. An attack of asthma may be brought on by the inhalation of such minute quantities of horse protein as are contained in the air near horses. Horsehair and the hair of cats and other animals may cause the same reaction. Likewise hay-fever is caused by the pollen of various plants—goldenrod, ragweed, etc.—and skin eruptions by poison ivy and sumac. Many foods, such as eggs, milk, pork, shell-fish, and many fruits and vegetables, may act as poisons to persons who are hypersensitive to them.

The specific cause of all these reactions may be determined by means of cutaneous tests which are made by scarifying the skin and rubbing into it a minute portion of the protein to be tested. A local reaction at the point of inoculation indicates a positive test.

Desensitization may be brought about by the injection of minute doses of the specific protein or by the feeding of small and non-toxic amounts of the food causing the reaction. In some cases of hay-fever and asthma a great deal of relief has been afforded by this treatment.

Antitoxins.—In producing *active* immunity the whole process is developed in the system of the patient; in producing *passive* immunity, half the process is developed in

one of the lower animals. The immunizing agent is contained in the serum of an animal, usually the horse, which has been injected with repeated increasing doses of a bacterial *toxin* until an extremely high degree of resistance has been developed. The serum is injected under the skin of a patient suffering from the disease, and after a varying number of doses produces a temporary immunity in the patient. Such a serum is spoken of as an *antitoxin*. Antitoxins are thus produced from the toxins of diphtheria, tetanus, streptococcus infections, pneumonia, cerebrospinal meningitis, and a few other infections. At the present day the use of diphtheria antitoxin is universal, and has enormously reduced the death-rate of this malady. Tetanus antitoxin is considered efficacious as a prophylactic if injected at the time of an injury or soon after, but is not considered of much use once the disease has manifested itself (p. 418). The use of antistreptococcus serum is gaining in favor in many parts in the treatment of general sepsis.

Technic.—In producing an antitoxin the procedure practised at the present day is as follows: the bacillus of diphtheria, for example, is cultivated in a bouillon and developed in an incubator. In growing, the bacillus excretes its toxin, which permeates the culture-media. When sufficient toxin is formed, the culture is filtered to get rid of the living bacteria, and a small dose is injected into a horse, with the result that a mild attack of diphtheria is developed. From time to time fresh injections of the toxin are administered, until the horse is able to receive enormous doses of the toxin without developing symptoms of the disease. The horse is then bled, and the serum, which contains the immunizing agent, is collected and put up in hermetically sealed tubes, after the strength of the serum has been tested on guinea-pigs, rats, or similar animals.

Measurement.—The antitoxin serum is measured by its *potency* and not by its bulk. The standard of measurement has been named the *immunity unit* by Behring, the scientist who first introduced the methods of developing and using antitoxins. *The unit represents an antitoxic principle sufficient to enable a guinea-pig weighing 250*

grams to resist an injection of the toxin 100 times stronger than a normally fatal dose for four days (Williams).

Persons exposed to diphtheric infection usually receive an injection of 500 to 1000 units; patients with diphtheria, 4000 to 8000 units at a time, repeated at intervals until the physical symptoms show a decided improvement.

Passive immunity is developed much more rapidly than active immunity; in many cases the effects of a dose of antitoxin are perceptible in a few hours after the first injection. The immunity thus conferred is, however, transitory; whereas, as we have seen, in many instances *active* immunity may last through life.

Without the phenomenon of *immunity*, either natural or acquired, the human body would be a constant prey to infectious diseases; bacteria once invading a body would continue to develop and produce their toxins until the death of the victim took place.

Theories of Immunity.—Many theories are advanced to explain the phenomenon of immunity, no one of which is yet considered conclusive. Pasteur held that during an attack of an infectious disease the bacteria fed on certain organic elements in the body until the supply was exhausted, following which the bacteria were starved out; immunity then lasted until this necessary food was renewed in the body, in many instances for the rest of the life. This hypothesis is known as the *exhaustion theory*. Others hold that bacteria, by their own excretions, produce a medium in which they cannot develop. Others again attribute immunity to chemical changes in the blood, the result of bacterial activity, which give to the blood certain bactericidal powers, such as the development of bodies known as *alexins*, which, by a complicated process, have the power of dissolving bacteria (*bacteriolysis*).

Other substances produced in the blood during certain infections are called *agglutinins;* they cause clumping or *agglutination* of certain bacteria, with a loss of motility where the bacteria have this property. We have seen that the blood of typhoid-fever patients has this property. (See Widal Reaction.) It is not yet determined whether the agglutinins play an active part in the production of immunity.

Without directly bearing on her work, it is worth while for the student nurse to understand those theories on this subject most generally referred to, and to which she will frequently find allusion in the text-books she may consult.

1. **The Theory of the Feeding Cell.**—Experiments show that certain of the leukocytes, or white corpuscles, have the property of fastening on certain substances in the blood and ingesting them. From this property they are called *phagocytes*, or feeding cells. The phagocytes are the scavengers of the body. If a part of the body receives an injury, we know that at once there is a migration of leukocytes to the point of lesion; these, fastening on the inflammatory processes, ingest them, sometimes destroying them, sometimes conveying them to remote parts of the system. Where their efforts are successful, we say that the inflammatory processes have become *absorbed*, or that *resolution* has taken place.

Metchnikoff, a modern scientist, proposed (about 1890), as a theory to explain the action on the body in encountering bacteria, a similar attraction of the part of the leukocytes for bacteria invading the system. We may imagine the invading bacteria being met by a host formed of leukocytes. If the leukocytes win in the struggle, the bacteria are destroyed; but if the leukocytes fail to defend the body, the bacteria are victorious, and the body succumbs to the disease. The theory, however, falls short in many circumstances. For example, it does not explain immunity from infections produced by toxins excreted by the bacteria.

2. **Ehrlich's Theory.**—A second theory of immunity advanced by Ehrlich to explain the resistance of the body-cell to toxins is more difficult to follow. It pictures hypothetically each body-cell as being surrounded by a number of molecules which he calls *side-chains*. The function of these bodies is to attract the necessary food-substances for the cell. Each molecule of a side-chain is called, from this fact, the *receptor*. The receptor has a peculiar shape into which it is necessary for the food atom to fit exactly, as one piece of wood may be dove-tailed into another or a ball may fit exactly a socket. A food-atom fitting ex-

actly to the receptor is then passed into the cell, where it is devoured by the many atoms which comprise, according to this theory, the body-cell.

Ehrlich now imagines the invading bacteria to produce substances (toxins) of the same form as the food molecules, and, therefore, also fitting the receptors. These bodies are pictured in two parts. The first, to which he gives the name *haptophore*, is the body that must exactly fit the receptor. To the haptophore is attached a poisonous substance, the *toxophore*, which is thus introduced into the receptor by the haptophore, and through the receptor invades the cell which it attempts to destroy. A conflict now takes place between the toxophores and the cell atoms. If the former prevails, the cell is destroyed. In many instances, however, the presence of the toxophore excites the cell to abnormal activity, with the result that many additional side-chains are developed—more than are necessary to the individual cell. The superfluous receptor is thrown into the blood-stream and there meets the toxin molecule (*haptophore and toxophore*), which it engages, thus preventing the harmful molecule from reaching the cell. Should a sufficient number of receptors be present in the blood-stream to engage the large majority of toxin molecules, the effect is to neutralize their activity and immunity results.

This theory demonstrates immunity by the development of a neutralizing body or antitoxin, which has an affinity for the molecules of a soluble toxin developed in the body as a result of bacterial activity. It is a condition of *acquired immunity*. It may also serve as an illustration of natural immunity. As it is necessary for the haptophore exactly to fit into the receptor, should the cell possess no receptor into which the haptophore will fit, the cell will be safe from the invasion of that particular toxin molecule. The knowledge of antibody production in the body has led to the development of many laboratory tests for specific diseases. The most valuable of these are the typhoid agglutination test and the various complement-fixation tests, of which the *Wassermann* reaction is the most important.

3. **The Opsonic Theory.**—In quite recent years much attention has been attracted to what is known as the opsonic theory of immunity, advanced by Sir A. E. Wright, of London.

Wright teaches that in the blood-serum are certain substances which he calls opsonins, from the Latin word *opsono*, I prepare for dinner. This substance apparently acts on the bacteria in such a way as to prepare them as food for the leukocytes, or, on the other hand, it may act on the leukocytes so as to stimulate their appetite for the bacteria. Experiments show that there is no attraction between the leukocyte and the bacterial cell except through the medium of the blood-serum. The resistance of the body, according to Wright's opsonic theory, depends on the presence of the *opsonins*. The amount of "opsonins" present at different times varies greatly, causing a corresponding variation of the amount of resistance shown by the body to the invasion of bacteria. Wright teaches that this substance is either produced or increased by the presence of *dead* bacteria. In the ordinary course of an infectious illness a large number of bacteria die, and by this theory become themselves the source of this immunizing power.

In carrying this hypothesis into practice, bacteria that have been devitalized by heat are injected into the circulation of the patient, with the result of increasing the "opsonins" and hastening the period of immunity or establishing a cure. Each bacteria apparently produces only its own variety of "opsonins." For example, an injection of dead tubercle bacilli does not increase the resistance of the body to any bacteria except the tubercle bacillus.

This teaching of Sir A. E. Wright has opened up a new method of treatment for many infectious diseases by repeated injections of devitalized preparations of the germ which causes the specific disease. This method of *bacterial inoculation* has had its most notable results in the treatment of typhoid fever and cholera. To its use is due the remarkably low percentage of either of these diseases among the armies in the late war. Inoculation may be

used as a prophylactic measure on those to be exposed to infection, or in the treatment of the disease itself. The number of diseases capable of being combated by these *vaccines*, as they are called, is constantly being added to. The practice has also met with great success in the treatment of skin diseases.

Vaccines have been prepared from many of the infectious bacteria, but not all are valuable. Mixed vaccines of staphylococci, streptococci, pneumococci, micrococcus catarrhalis, and bacillus influenzæ are often valuable as prophylactic agents to those subject to colds and attacks of influenza.

Meningococcus vaccine has been found to have no preventive effect, but has been valuable in curative treatment in some cases. *Autogenous* vaccines, or those made from the organism isolated from the patient, are valuable in infections of a pyogenic nature, especially in chronic cases, such as furunculosis and acne, and in the subacute stages of a localized streptococcic infection.

In connection with this treatment the term *opsonic index* is met with. The index of an individual represents the degree of *opsonic potency* his blood-serum evinces toward a particular germ. This is ascertained by taking a counted number of leukocytes which have been isolated from the patient's blood and mixing them, in some of his own serum, with a known number of devitalized germs of the infection under consideration. After a period the bacteria are again counted. Say, for example, that in a given case it is ascertained that each leukocyte will account for six bacteria—the patient's index is said to be 1 in 6.

Under treatment, *i. e.*, by injection of devitalized bacteria, the opsonic potency may be greatly increased, each leukocyte accounting for a larger number of bacteria; the index is then said to be raised. Conditions which lessen the normal resistance of the body as described above cause the opsonic index to be lowered. Repeated examinations of the blood are necessary to keep watch on the opsonic index, and the injections are given according to the indications of the index.

The above are only epitomes of theories of immunity on which an immense amount has been written in later years. They will serve, however, to present a picture to the imagination of ways by which, in the first place, the bacteria themselves, and, in the second place, the toxins they produce, may be met and overcome in the body tissues. We must remember that these theories are all links in a chain of evidence that is slowly being accumulated by patient research and logical deduction. A discovery of to-morrow may alter the whole teaching of to-day, or, on the other hand, may establish what has been regarded as a doubtful hypothesis as a principle of the first importance.

ACTION OF PATHOGENIC BACTERIA

To return once more to the consideration of the action of the pathogenic bacteria on the tissues:

Incubation Period.—Between the actual time that the germ of a specific disease gains entrance to the body and the development of the first symptoms of the disease is a period of apparent quiescence known as the *period of incubation.* This period varies in the different diseases and to some extent also in the same disease in different patients, depending probably on the resistance of the individual. During this time the toxin is being developed. As the toxins begin to be absorbed by the tissues the preliminary symptoms or *prodromes* make their appearance.

The average time of incubation in the infectious fevers is as follows:

Diphtheria	Two to seven days.
Scarlet fever	A few hours to seven days.
Smallpox	Ten days to two weeks.
Chicken-pox	Fourteen to sixteen days.
Measles	Ten days to two weeks.
German measles	One to three weeks.
Typhoid fever	Two to three weeks.
Typhus fever	A few hours to two weeks.
Mumps	Two to three weeks.
Erysipelas	Three to seven days.
Tetanus	A few days to three weeks.
Cholera	Two to five days.
Yellow fever	Two to three weeks.

—*From A. A. Stevens.*

Surgical infection due to a variety of the staphylococcus or streptococcus bacteria requires about three days for incubation. The methods of combating surgical infection are discussed in the following chapter.

Period of Invasion.—Immediately following the period of *incubation* is the period of *invasion*, corresponding to the elaboration of the toxins and the beginning of their absorption by the tissues. During this period the temperature rises until it reaches its height. It is accompanied by physical manifestations, such as malaise, languor, gastric disturbances, chilliness, or rigors, and in some cases by characteristic premonitory symptoms of the special disease, which are known as *prodromes*. Such, for example, are the coryza of measles, the sore throat of diphtheria and scarlet fever, and others.

Fastigium.—The significance of the *fastigium* and the *decline* of a fever have already been briefly pointed out. (See also p. 157). The fastigium is the period of *toxemia* during which the body-cells are poisoned by the toxin elaborated by the activity of the bacteria. Besides the characteristic symptoms of the special disease, the condition is accompanied by general symptoms common to the acute infectious disorders, of which the most important are fever, prostration, emaciation from interference with the processes of nutrition, digestive disorders, especially constipation or diarrhea, and nervous symptoms, such as wakefulness, delirium, stupor, or unconsciousness.

The **decline** is coincident with the elaboration in the body, probably we have seen in the blood, of substances with antitoxic properties, and ushers in a period of *immunity* of greater or less duration.

At the present day, except in one instance, no remedy is in general use which will actually cut short an infectious fever. The treatment of such cases is entirely directed to the amelioration of the symptoms and the support of the bodily strength by confinement to bed, quiet, and judicious diet. The exception is the use of antitoxin serum in diphtheria, the remedial effects of which are frequently demonstrated in a few hours after the injection of the serum.

Drugs with Specific Action.—In the department of materia medica a few drugs are recognized as having a specific effect on certain infectious disorders. Such are quinin, largely used as a prophylactic in malaria; salicylic acid, which relieves the pain and reduces the fever in acute rheumatoid affections; mercury and iodid of potassium and arsenic preparations largely used in the treatment of syphilis; ethylhydrocuprein (optochin) which has recently been proved to have a specific action on pneumococci.

As has already been stated, the scientists of the present day are devoting much of their time and energies to the discovery of immunizing agents for the various infectious disorders, which shall prove as effectual as the diphtheria antitoxin has been shown to be. Their work is, however, still largely in the experimental stage.

NURSING IN INFECTIOUS DISEASES

In nursing an infectious fever the sources of contagion must be recognized and protective measures taken accordingly. It must be remembered again that the germs of a disease are usually found in greatest numbers in the lesions characteristic of the disease. Any abnormal discharge, therefore, the result of the disease, will probably contain the germs of the infection, and must invariably be disinfected.

In the water-borne diseases, typhoid fever, cholera, dysentery, and summer diarrhea, the special lesions being in the alimentary tract, the stools are the chief source of infection, and must be rigorously disinfected until convalescence is established.

In **typhoid fever** the usual rule is to consider convalescence established ten days after the temperature has become normal. Until this time the bed-linen must also be disinfected, and the dishes and utensils used for the patient should be marked and set aside for his use only. The diapers of a baby with summer diarrhea should be placed in a disinfectant immediately after they are removed.

In typhoid fever the bacteria are frequently present in

the urine, which should, therefore, also be disinfected. (See Disinfectants.) The germs may also be found in any discharge from a suppurative condition, in the vomitus, and in the sordes which collect about the teeth and lips of patients where the mouth has been neglected. In this latter condition the germs may also be in the breath. To those attending these cases the chief source of danger lies in getting the hands infected while attending to the patient, changing the bed-linen, or cleaning the mouth. It should be a rule with no exceptions that the hands must be washed and disinfected after every such act, and again invariably before going to a meal.

In disposing of the stools, they should be disinfected (p. 443) before being thrown down the soil-pipe. In country places, where there is no water drainage, a hole should be dug and the stools placed therein and covered with lime. Great care must be exercised to choose a site away from all water-supply, and especially from natural wells. When the case is over, the bed and bedding should be disinfected.

With the above precautions and scrupulous cleanliness, typhoid fever cases and cases of dysentery or diarrhea should not be a menace to the health of the other inhabitants of a house. Wherever possible they should be nursed in a room by themselves, but the room need not be isolated, in the strict sense of the word. Cholera appears to be more actively contagious, and cases should be isolated.

Diphtheria.—The germs in a case of diphtheria are present in the discharges of the nose and throat, consequently in the breath, and especially in the characteristic membrane. All such discharges, the sputum, the pieces of membrane, and vomitus must be disinfected. Sputum, etc., should be received on pieces of rag or paper and burned at once, if possible. If not, they should be thrown in a covered vessel containing a disinfectant until destroyed.

The air immediately round the patient may contain germs, but the infection is not carried by *fomites*, unless actually soiled with the discharges. Since the breath is infected, kissing or nursing child patients in the arms

is forbidden, and the nurse must be careful to avoid letting the patient cough in her face. The patient should be *isolated*, and all vessels and dishes kept for his exclusive use. The linen must be disinfected before being sent to the laundry, and should be washed separately. The patient is actively infectious as long as there is any cough or discharge from the throat or nose. He is not recognized as free from contagion until no culture of the Klebs-Löffler bacillus can be obtained from the throat, three negative cultures on successive days being required before the patient is discharged.

Disinfection should include fumigation of the room and disinfection of the bed, bedding, furniture, etc., followed by thorough cleaning. In a private house the walls should be repapered.

Scarlet fever is one of the most actively contagious of diseases. The germs are present in discharges from the nose and throat, or any other suppurative condition, such as *otitis media*, and in the particles of epithelium shed after the rash has faded. Desquamation lasts from four to eight weeks. As long as there is the smallest particle of desquamation or any discharge from throat, nose, or local abscess, the patient is in an infective condition, and must not mix with others. In these cases *strict isolation* is imperative. The room chosen should be as far removed as possible from the rest of the house. The doors should be kept closed, and a curtain, kept continually wet with a disinfectant, should be hung in front of the entrance communicating with the rest of the house.

The same precautions should be taken as in diphtheria. In addition, the separated particles of epithelium must be destroyed. Many doctors keep the skin lubricated with an antiseptic ointment or oil, and, in addition, after the fever has disappeared, daily hot baths are given to encourage desquamation.

The sweepings of the room will probably contain the germs of the infection, and should, where practical, be burned at once. Even in the summer they may be wrapped in a newspaper and burned on the hearth or in an empty garbage-pail. Dusters and sweeping brooms should be disinfected and washed daily after use.

Scarlet fever infection is also conveyed by fomites. Every unnecessary article in the sick-room is, therefore, a future menace. Letters, books, work, toys, actually handled by the patient cannot, as has been said, be disinfected with any certainty. What are not destroyed are generally welcomed in a fever hospital.

Nurses taking care of such cases should not go to the other rooms of the house, and should not associate with others unless out-of-doors, after their clothes have been changed and they have taken a bath. Clean linen wrappers should be provided to cover entirely the clothing of doctors or visitors to the sick room.

When convalescence is complete, the patient receives a thorough disinfecting bath and is dressed in clothes that have not been near the sick-room. The room and all the contents are fumigated and cleaned. Repainting and papering should be done where possible. Whitewash is in itself a disinfectant, and is generally practical in the homes of the poor.

Smallpox is the most readily communicable of all diseases. Infection is conveyed in the breath of the patient, the discharges of the nose, mouth, and conjunctiva, in the vomitus, sputum, probably in the excretions, and in the desquamating skin.

The care to be taken is the same as in scarlet fever. The fomites are peculiarly tenacious of the infection, and everything practical used by the patient should be destroyed except articles that can be boiled or disinfected with certainty. Old linen and old bedding, if available, should be used and destroyed when finished with. The room should contain the least possible amount of furniture and absolutely no rugs, hangings, or decorations. After fumigation, walls, ceilings, and floors must receive special cleaning. Repapering or white washing is imperative. In epidemics temporary huts or canvas tents are preferred to more permanent buildings.

Protection for the attendants lies in vaccination. No nurse should be permitted to go on duty on a smallpox case unless vaccinated successfully within two years, and all likely to come in direct or indirect contact with the case should be vaccinated.

As in scarlet fever, infection lasts as long as there is any discharge from the surface or cavities and until desquamation is entirely finished.

Measles.—The infection of measles is also contained in the discharges of the nose and throat and in the desquamating skin. Measles appears to spread more quickly through a community or a hospital ward than any other infection. The reason is probably the *droplet infection* from the accompanying coryza. For this reason, if measles is suspected, the patient should be isolated on the earliest appearance of the coryza. The same may be said of whooping-cough. Cases of measles should be isolated until desquamation is over. In all respects the precautions are the same as those used in scarlet fever. As desquamation is much less severe than in scarlet fever, the fomites are more readily disinfected.

Chicken-pox, German measles, mumps, and **whooping-cough,** all air-borne infections, should also be isolated and precautions taken along the lines indicated.

Tuberculosis.—The tubercle bacillus attacks practically all organs and structures of the body. The lesions are frequently complicated by suppuration, and in these cases the discharges contain the bacillus and must be disinfected or destroyed. Pulmonary tuberculosis is the most generally infectious variety of this disease. The infection is contained in the sputum, and communicated to the air by droplet infection, or directly from the breath of the patient in kissing or in sleeping in the same bed.

In nursing a case of pulmonary tuberculosis isolation should always be attempted and enforced where possible. The minimum care should insist on separate sleeping room and separate linen, dishes, and utensils for the patient's use. The sputum should be received in special cups or flasks which can either, according to their make, be burned or disinfected by boiling at least once a day. Patients must be taught to spit only into the cups and to keep clothing, hands, etc., free from contamination. Handkerchiefs, if these must be used, should be disinfected before being sent to wash, and *boiled* in the process. The bed and personal linen should also be disinfected. In

poor homes rags and pieces of soft paper should be given to the patient and he should be taught, after using them, to put them in a thick paper bag in which they can subsequently be burned. Nurses should remember that, whatever compromises they may be obliged to make, scientists consider that *isolation* of the case from healthy people is the most important of all means of prophylaxis.

Erysipelas.—The infection of erysipelas is contained in the desquamating particles of skin and in discharges from the affected area. It is readily carried in the clothing of the attendants, and in instruments, dressings, etc., used for such cases. At the same time, as an abrasion of the skin is necessary for the entrance of the special germ, cases of erysipelas may be nursed with impunity in medical wards. Care should be taken to prevent any contact, however remote, with surgical cases. Nurses caring for erysipelas patients should not be allowed in the surgical wards or in the operating-room, and should not mix with others from these departments until the clothes have been changed. Dressings from erysipelas cases should be burnt where practical.

The consideration of protection from surgical infection involves the whole process of modern surgical technic, and must be considered in a chapter by itself.

CHAPTER XII

SURGICAL BACTERIOLOGY, ASEPSIS

Micro-organisms Commonly Met With in Surgery—Infection—Principles of Antisepsis and Asepsis—Sterilization by Heat—Arnold Sterilizer—Autoclave—Chemical Sterilization—Antiseptics in General Use—Disinfection by Vapor—To Disinfect a Room—Measuring Solutions.

MICRO-ORGANISMS MET WITH IN SURGERY

The bacteria now recognized as the common source of surgical infection belong, for the most part, to the micrococcus group. Those most frequently encountered are of the *staphylococcus* or the *streptococcus* variety. They are classed as **pyogenic,** or pus-producing, bacteria.

The principal varieties of these bacteria have already been described on page 379.

WOUND INFECTION

Bacteria that cause the acute contagious fevers are present only in more or less localized areas, and are looked for chiefly in the vicinity of persons suffering from these maladies. The pus-producing organisms, on the contrary, are widely distributed, and are specially liable to be found in the ordinary dust of human habitations, which must, therefore, be regarded as a source of infection for surgical wounds. Many of them are constantly found on the skin and on the mucous membrane surfaces, especially of the nose and mouth, and even in the alimentary canal.

These bacteria invade the body through the broken surface of the skin or mucous membrane. They may be conveyed by the dust of the air, by water or lotions used in irrigating wounds, or by unclean articles that come in contact with the wound, such as dressings, instruments, or the hands that touch the wound. A wound invaded by pyogenic bacteria is described as *infected.*

As we know, the bacteria do not themselves actually attack the tissues. The symptoms resulting from their invasion are due to the toxins they elaborate during their development.

At the seat of lesion the effect of staphylococcic infection is—(1) local inflammation; (2) necrosis of the inflamed tissues; (3) liquefaction of the necrosed tissues. The liquefied tissue, mixed with the cells of dead leukocytes, forms the thick, inoffensive, yellowish-green fluid we know as *pus*. A local, circumscribed collection of pus is called an *abscess*.

Suppuration.—The breaking down of the tissues into pus is known as *suppuration*.

The local condition of suppuration gives rise to certain general symptoms, of which the most important is a sharp rise of temperature, preceded, as a rule, by attacks of shivering, and accompanied by general malaise. The physical symptoms are due to absorption of the local toxins. They subside quickly if the abscess is opened, and further absorption checked by drainage.

Occasionally the *staphylococcus* gains entrance by way of the hair-follicles, the skin apparently remaining unbroken. A *pustule* is produced at the point of invasion; under treatment the infection may be checked at this point, or it may spread to the surrounding tissues, producing a *boil*, or, where the deeper tissues are extensively involved, a *carbuncle*.

Infection by the *streptococcus pyogenes* is accompanied by severe physical symptoms. The principal are: high fever of the intermittent variety, preceded by rigors (attacks of intense shivering), rapid emaciation, marked prostration, and persistent diarrhea; the intermissions of fever are accompanied by profuse sweating. In many instances the condition is fatal. The term *blood-poisoning* is often used to describe general streptococcus infection.

The **incubation period** for the pyogenic bacteria is usually about three days; it is, therefore, frequently possible to trace the origin of the infection by the time of the development of the symptoms.

Mixed Infection.—Not infrequently an infected wound

may be invaded by a second organism, both of which continue their activity in the same tissues. The condition is then described as *mixed infection.* The most common example is infection by the pyogenic organisms in tissues already infected by the tuberculosis bacillus. This is the process that produces the *cavities* in the lungs of phthisical patients, the *strumous glands,* and joint abscesses especially common in tubercular children.

The tissues of a healthy human being present a considerable resistance to the invasion of the staphylococcus and streptococcus organisms. As with other pathogenic bacteria, this resistance is lessened by conditions that lower the health or vitality of the individual, and especially by alcoholism and by chronic organic diseases, such as diabetes. Of special importance is it to remember that local resistance is lessened by local injury to the tissues, such as laceration, bruising, or other damage from an accident, or even from rough handling of the tissues during an operation or dressing. Other local conditions that lessen the resistance are edema, hyperemia, anemia, and the presence of dead tissues or other foreign bodies that act as irritants. To some extent antiseptics also tend to irritate the tissues, and their use is by many surgeons almost entirely eliminated.

A wound made by sharp instruments and where the tissues are carefully handled and little disturbed offers a considerable degree of natural resistance to bacterial invasion.

Bacillus of Tetanus.—Another organism especially to be guarded against in surgery is the *bacillus of tetanus,* which is especially liable to infect wounds of accidental origin, and particularly those contaminated by the soil. The tetanus bacillus is found in the soil, and especially in soil covered by the feces of herbivorous animals. Usually the organism gains entrance to the system at the time of the accident, but open wounds, particularly wounds of the hands and feet, may readily become infected later. In wounds caused by blank cartridges the tetanus germ is particularly liable to develop. The source of the infection appears commonly to be the wad of the car-

tridge, but the germ is probably frequently also present on the soiled hands or clothing of the victim, and is driven in at the time of the accident.

The tetanus bacillus is of the *strict anaërobic* variety, that is to say, the *absence of oxygen* is essential to its development. Punctured wounds and those caused by gunshot, both of which reach the deeper tissues with small external opening, offer, therefore, conditions peculiarly favorable to the growth of this organism.

The tetanus bacillus produces no special local manifestations, but marked characteristic physical symptoms, the most important of which is the typical convulsion (p. 669). The acute form of this infection is very frequently fatal.

Antitoxins are prepared for the treatment of tetanus and of streptococcus infections. In the late war a dose of tetanus antitoxin was given to each wounded man before he was removed from the field. To this is due the fact that tetanus rarely developed in the army hospitals, whereas in all former wars death from tetanus infection enormously increased the mortality of the armies.

Bacillus Aërogenes Capsulatus (Gas Bacillus).—This is an extremely virulent infection which also attacks wounds of accidental origin and, like the *tetanus bacillus*, is found in the soil of certain districts. The tissues surrounding wounds in which this bacillus develops become infiltrated with gas; the physical symptoms are those of profound toxemia. The local treatment includes free incision of the tissues to allow the gas to escape. Like the tetanus bacillus this organism contains *spores*, a point to be remembered in disposing of dressings, etc. Flanders is a district in which the gas bacillus is found, and this infection was frequently seen among the wounded from the trenches. A specific serum has been produced which is valuable in preventive treatment, but is of no value when the wound has reached the stage of septicemia.

ANTISEPSIS AND ASEPSIS

Antisepsis.—As we saw in the last chapter, it is only of comparatively recent years that the sources and channels of infection have been recognized. Following Lister's

deduction, that sepsis and suppuration were the result of the activity of micro-organisms produced by a process strikingly similar to the familiar phenomenon of fermentation, the efforts of the surgeons were directed toward devising means that would protect the tissues from the invasion of bacteria.

Experiments showed that certain drugs possessed the property of destroying or, at least, arresting the activity of these germs. The use of such drugs which were now classed as *antiseptics* in the preparation of dressings, in the cleansing of the hands, of the instruments used, and also of the skin of the field of operation, and, finally, the saturation of the air during the operation by an antiseptic spray, constituted the practical outcome of Professor Lister's teaching, and was known as the *antiseptic* method of treating wounds.

The antiseptics most in use were carbolic acid, bichlorid of mercury, chlorid of lime, chlorinated soda, and iodoform, the latter as a powder applied directly to wounds, and at that time extensively used.

The air was saturated by means of a fine carbolic steam spray, which was kept playing over the whole field of operation during each operation or dressing. The instruments were covered with carbolic solution some hours before each operation or dressing, and kept in the solution except when actually in use. In dressings, the old-fashioned poultice or ointment, spread on lint, was replaced by loose-meshed gauze, saturated with a disinfectant, and medicated absorbent cotton; the wound itself was cleansed with an antiseptic and powdered with iodoform. Sea-sponges used for cleaning were carefully washed after use and kept soaking in a disinfectant. Subsequently their use was superseded by sponges made of gauze or cotton and discarded after use.

The results of Professor Lister's methods completely justified his theories. Epidemics of "hospital fever," or blood-poisoning from infected wounds, until then constantly breaking out in hospital wards, disappeared; wounds, closed at the time of operation, healed without suppuration. It was demonstrated that the cavities of the body could be entered, and operations performed on im-

portant structures without such a proceeding being followed by a general septic condition. It is difficult to realize that forty years ago these familiar facts were looked upon as tentative discoveries.

Antiseptic methods spread from the operating-table to all departments connected with the care of sick people. From disinfecting the air during an operation, the necessity came to be recognized of protecting the air from impurities by rigid cleanliness and antiseptic principles applied to domestic work. Absolute cleanliness, no longer a mere esthetic principle, was now recognized as a practical necessity in wards, operating-rooms, and all departments of a hospital for the prevention of infectious conditions. Dust and dirt, now found to be the favorite harboring places of pus-producing germs, were rigorously removed; in hospital construction and equipment materials that easily absorbed dirt and, therefore, bacteria, such as unpolished wood for floors or furniture, wall-papers, carpets and hangings, disappeared; hard wood capable of being highly polished was largely used, and later marble, cement, glass, or metal, all presenting hard, smooth, nonabsorbent surfaces, were proved to be the materials most readily kept free from germs.

The same principles were applied to the clothing worn by those attending the sick, requiring that it should be made of washable material, especially of linen, which, when ironed, prevents a smooth, polished surface, less readily absorbent than many other materials.

Fresh air and sunlight were proved to be natural antiseptics, and were now freely admitted to wards and sickrooms, hitherto most frequently kept close and stuffy.

The practice of disinfecting the air by means of the carbolic spray comparatively soon fell into disuse. The air purified of dust was found to be also freed from germs, and it was not considered to be of practical value to saturate it with a disinfectant. Otherwise antiseptic principles, with various modifications and developments, were the accepted methods for some twenty years. For the last twenty years, however, asepsis has, at first gradually, and later almost entirely, superseded antisepsis by really direct logical sequence.

Antiseptic methods protected a wound by keeping it constantly surrounded by agents that destroyed bacteria or, at least, bacterial activity. It had certain disadvantages: if the agents were used in sufficient strength adequately to fulfil their function, many of them actually injured the tissues or the instruments, etc., used, and others had a toxic effect on the system.

Asepsis.—The method we know as asepsis (literally, without poison) was developed from the principle that contamination of a wound came from without; therefore, if a wound were protected from contamination, there would be no development of manifestations attributable to germ activity, and it would not be necessary to apply antiseptics to the wound itself.

To attain this, the room in which the wound is to be exposed must be free from germs and of dust, which is the common carrier of germs; the instruments and dressings, the hands of the operator and assistants, everything, in fact, that might come into direct or indirect contact with the wound, must be made free from bacterial invasion and kept so during the entire time the wound should be exposed.

An illustration may serve to make clear the similarity of principle and the difference in methods in antiseptic and aseptic surgery.

Suppose a hall filled with treasure and invaded by a band of thieves, who will destroy and carry off the treasure; let us take the hall and its treasure as representing the wounded tissues, and the band of thieves as a horde of bacteria. Now, let us imagine that the thieves have been followed by a guard sufficient in numbers and force to hold the thieves in check. The treasure is, for the time being, safe, and will remain so as long as the guard is stronger than the thieves. This we may take as representing the *antiseptic* principle.

The aseptic principle may be demonstrated by picturing the same hall into which, by vigilant care outside the door, thieves have not been allowed to enter. There are no thieves, no guard is necessary; but if vigilance is relaxed, if one gate of admission is unprotected, the hall lies completely at the mercy of the invading band. To

carry the illustration a little further, the gates of admission are represented by the instruments, dressings, and all solutions or apparatus that come in contact with the wound, by the hands of the operator and all who assist at the operation, by the surrounding air, and by the surface of the skin covering the area of operation.

It is necessary that these should, in the first place, themselves be free from bacteria, and that, once rendered free, they should be kept in this condition all the time the wound is exposed.

STERILIZATION

Substances or bodies entirely free from bacteria are said to be *sterile*, and the process by which they are rendered so is called *sterilization*.

While antiseptic methods obtained in surgery, sterilization was carried out entirely by the use of chemical agents, that is to say, by the use of antiseptics, in most cases producing not true sterilization, but merely a partial or temporary arrest of bacterial activity. In developing aseptic methods in surgery from the antiseptic methods, the limitations of chemical sterilization were recognized as a stumbling-block, and attention was turned to more effectual and reliable means of accomplishing the desired result.

Sterilization by Heat.—For instruction, the surgeons turned to the bacteriologic laboratories. It was found that even highly resistant bacteria could be destroyed by being subjected to a high temperature for a definite period. In the laboratories sterilization was accomplished by the actual flame, by baking, by boiling, and by steam. Ingenuity set to work to devise means by which perishable substances, such as dressings and delicate instruments, could be brought to the necessary temperature without being burnt or otherwise destroyed. As results, we have the varieties of sterilizing apparatus familiar at the present day in modern surgical methods.

It is interesting, in this connection, to realize that in the early laws of the children of Israel the purifying property of heat was recognized. We read in the book of Numbers (Ch. xxxi, 23): "Everything that may abide the fire ye

shall make go through the fire and it shall be clean," and, it is added, "all that abideth not the fire ye shall make go through the water."

Actual Flame.—Sterilization by the actual flame is the least used form of sterilization. It is applicable to small articles, such as needles, platinum wires, cautery-tips, etc., which can be made red hot without melting. An alcohol lamp or a Bunsen gas-burner is used for the purpose, the flame of either being free from soot or impurities that would adhere to the article sterilized.

Boiling was found a practical method of sterilizing, and was at once adopted for fluids, for instruments, basins, and vessels of metal, china, or glass, and all substances where boiling is practical.

Boiling, to be effectual, must be done in a closely covered vessel, containing sufficient water completely to cover the articles to be sterilized. The time necessary for complete sterilization is usually considered to be fifteen minutes of actual boiling. Fifteen minutes is, however, too long for some articles that stand boiling badly, such as rubber goods or fine sharp instruments, which become blunted in the process.

These articles are capable of being thoroughly cleansed previously of all deposits which might contain bacteria and greasy substances to which bacteria would readily adhere. Needles and knives which are made of highly polished metal without joints or grooves, are usually boiled for only thirty seconds, and rubber goods or sharp instruments that have grooves or joints, from three to five minutes (Chapter XIII). Practically, these articles are better sterilized by chemical means.

Baking, or sterilization by *dry heat,* was the earliest method employed in the sterilization of dressings, clothing, and all varieties of "dry-goods." A hot-air chamber was used, somewhat similar in principle to an oven. It consisted of a strong iron box with double walls, provided with a closely fitting iron door; the space between the walls formed an air-chamber in which the hot air was kept circulating. In institutions such a chamber was frequently built near a furnace, with which it was connected as an ordinary oven is with the kitchen stove. These chambers

were frequently of considerable size, and were used for the disinfection of mattresses, blankets, and the clothing of infectious cases. Articles were baked for one hour at temperatures not below 150° C. (302° F.). With so long an exposure to dry heat, however, perishable materials were scorched and burned, so that the method had great disadvantages.

Moist Heat.—Sterilization by dry heat was quickly replaced by sterilization by *moist heat;* in other words, by *steam.* Moist heat is more penetrating than dry, is not destructive to the extent of dry heat, and was proved to destroy bacteria as effectually and in a shorter time, fifteen to twenty minutes being sufficiently long for the destruction of highly resistant bacteria.

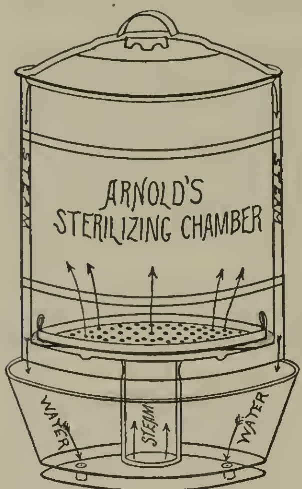


Fig. 148.—Arnold's steam sterilizer.

Since its introduction, sterilization by steam heat has replaced all other forms, wherever practical, and its use at the present day is universal.

Two methods of using steam are employed—steam just as it is generated by boiling, and steam under pressure.

Arnold Sterilizer. — The apparatus most commonly in use for sterilizing by steam without pressure is the *Arnold sterilizer.*

This is a simple apparatus in three parts—the sterilizing chamber, the jacket, and the water chamber.

The sterilizing chamber is a cylindric metal box, usually of copper, completely inclosed in a movable outer covering of the same metal, which forms the jacket; the whole fits closely over a wide copper pan filled with water, from which the steam is generated, forming the water chamber. The bottom of the sterilizing chamber is provided with an opening through which the steam is introduced. The

articles to be sterilized are packed on a perforated metal tray in the bottom of the chamber; the perforations allow the steam to percolate freely to all parts. Between the sterilizing chamber and the inclosing jacket a small air-space is left, which has two uses: First, it helps in maintaining an even temperature in the sterilizing chamber; second, the steam, coming in contact with the top of the covering, condenses, the water trickles down the sides of the jacket in the air-space, and returns to the water chamber through some small perforations at the bottom, thus, to a certain extent, replacing the water that has been converted into steam. The whole apparatus may be placed over a portable gas stove or on the kitchen stove.

Improvised Steam Sterilizer.—An adequate steam sterilizer may be made with a clothes-boiler. About a fourth of the depth is filled with water, above which the articles are suspended in an improvised hammock of net or muslin, fastened by strings to the outside handles. If the boiler is to be permanently devoted to the purpose, it is worth while to have it fitted with a shelf or tray of perforated metal, which can be hung from two hooks attached to the rim of the boiler. If dressings sterilized in this manner become wet, they should be dried at once in an oven.

In sterilizing with steam by this method *thirty minutes* should be allowed, *counting from the time the steam is generated.* It must be remembered that, although bacteria are destroyed at a temperature of 100° C., *spores are not.*

The Autoclave.—Steam under pressure can be raised to a higher temperature than steam generated at the ordinary pressure of the atmosphere. France was the first country to adopt sterilization under pressure, and invented the apparatus known as the *autoclave,* now in universal use in some form or other.

Whatever the shape or size of the autoclave, it consists essentially of three chambers: (1) A closed water chamber, communicating with (2) a closed steam chamber, which is usually in the form of a jacket, surrounding and communicating with (3) the sterilizing chamber. During steriliza-

tion the sterilizing chamber is completely closed by a heavy metal door screwed down so securely that no steam can escape.

The communications between the three chambers are guarded by valves which are regulated by handles placed on the outside of the autoclave. The water chamber is also filled from the outside. The steam chamber has attached to it a safety-valve to regulate the pressure to the required amount. For example, if fifteen pounds' pressure is wanted, the valve is set so that any pressure over fifteen pounds forces the valve up and allows sufficient steam to escape to reduce the pressure again to fifteen pounds. It is always of the first importance that this valve should be in working order.

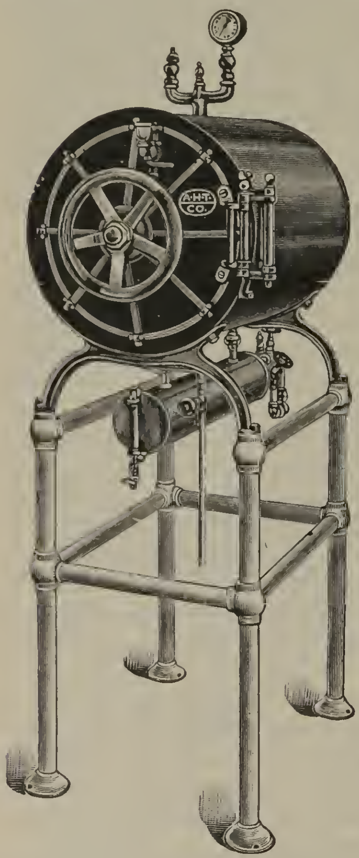


Fig. 149.—Autoclave. Horizontal form.

The autoclave is also furnished with a dial showing the pressure of steam and the temperature attained, and with a glass gauge by which the amount of water in the water chamber can be estimated.

The water in the chamber may be heated by gas placed below the autoclave. In institutions where steam is used for heating the autoclave is generally attached directly to a steam pipe, and gas is then not necessary.

The connection pipe is provided with a valve to regulate the amount of steam introduced, and a second pipe is necessary to carry off the superfluous steam.

The articles to be sterilized are placed on perforated metal shelves, with one or more of which the sterilizing chamber is provided. In packing the sterilizer with objects that expand under heat, sufficient space must be allowed for such expansion. Two articles that expand must not be placed near together; thus, glass flasks or jars will crack if set close to each other or directly on the metal shelf: the shelf should first be covered with a towel folded to several thicknesses.

Printed directions to be followed in the manipulation of the autoclave or sterilizer should hang where they can readily be referred to. At the same time, the pupils should be drilled in its use, and have each part carefully explained to them:

The steps in sterilizing are as follows:

1. Examine the water-gauge, and, if necessary, add more water.

2. Pack the sterilizer and close the door.

3. Either light the gas or turn on the steam; then immediately—

4. Open the valve between the water chamber and the steam chamber.

As steam is generated, the needle on the dial is seen to rise. When it reaches the desired pressure, and not before—

5. Open the valve between the steam jacket and the sterilizing chamber.

This, of course, reduces the pressure temporarily and the dial needle falls. Sterilizing does not begin until the needle shows a second time that the necessary pressure has been reached, this time in the sterilizing chamber.

When sterilization is complete, the heat supply is turned off. The door is not, however, opened until the needle indicates not more than five pounds' pressure. If the door is opened at a high pressure, the face and hands may be scalded, besides which the sudden change in pressure is liable to blow the corks and stoppers or the contents out

of jars and bottles containing fluids, and to cause cracking of glass flasks and similar objects.

The usual pressure required is *15 lbs.*, which represents a temperature of 120° C. or 248° F.; at this pressure sterilization is continued for fifteen minutes.

An autoclave similar in principle, and but slightly different in mechanism, is used to sterilize water where large quantities are constantly required. As the tanks containing the water are hermetically closed, water once sterilized will remain sterile until fresh water is added, after which sterilization must be repeated.

A temperature of 120° C. has a more powerful effect on bacteria than a temperature of 100° C. While the lower temperature will completely destroy fully developed bacteria in from fifteen to twenty minutes, it has no effect at all on the more resistant *spores* (p. 358). Fifteen minutes in an autoclave at 15 pounds' pressure will, it has been shown, destroy spores, while if either boiling, dry heat, or steam at ordinary atmospheric pressure is used, the spores must be exposed for a number of hours before they are destroyed. Few of the substances it is necessary to sterilize could be subjected to so prolonged an exposure without injury or completely changing their nature. To ensure that sterilization is complete, many hospitals use a *control* which is placed in each packet to be sterilized.

A patent sterilizer control (by A. W. Diack, Detroit, Mich.) consists of a small glass tube containing a sand-colored tablet which melts and turns red when sterilization is complete. A black string, attached to the tube, is led out through the wrapping by which the control can be withdrawn and examined. If the tablet is unchanged the sterilization is incomplete.

In some hospitals the control used is a slip of paper with the date written in indelible silver ink. This is placed in the middle of the package; if sterilization is complete the ink turns red.

Fractional Sterilization.—Where it is not practical to use steam under pressure, substances in which spores may exist are subjected to what is known as the *fractional*

method of sterilization. These are substances which represent media in which bacteria can live and propagate, such, for example, as gelatin, milk, and bouillon, etc., to be used as culture-media; oils, ointments; water to be used during operations, in the making of solutions, or for subcutaneous infusion; and so forth.

By the fractional method such articles are either boiled or subjected to steam heat (100° C.) for fifteen minutes on *three successive days*. At the first boiling all fully developed bacteria are destroyed. The intervening twenty-four hours is sufficient to develop most of the spores, and as full-grown bacteria they are destroyed by the second boiling. Any spores left will develop between the second boiling and the third, at which any surviving bacteria are completely destroyed. Between the sterilization the substance to be sterilized should be kept at a moderately high temperature—about 80° F.—to favor the development of the bacteria. Experiments show that this method is sufficient for the destruction of even the most resistant spores.

The principles that govern the sterilization of milk to be used as food are discussed in the chapter on Food Values.

Chemical Sterilization.—While sterilization by heat, or thermic sterilization, is used wherever practical, it is not applicable in all instances. Obviously, for example, it cannot be applied to living organic tissues. Modern asepsis has, therefore, retained from the antiseptic methods the practice of sterilization by *chemical agents*.

Three groups of these chemical agents are recognized, often loosely classed as disinfectants.

1. *Antiseptics.*—Their action is to arrest the activity and prevent the development of bacteria.

2. *Germicides.*—These actually destroy the bacteria. Antiseptics used in sufficient strength and over a sufficiently long period act also as germicides. They cannot, however, be used in such strength on living tissue. Germicides are, properly speaking, true disinfectants.

3. *Deodorants.*—Some antiseptics possess the property of neutralizing disagreeable odors; such are permanganate of

potash, carbolic acid, cresol, and lysol. Other substances have also these attributes, but no antiseptic property, as, for example, eau de cologne and toilet waters.

Antiseptics are used in the form of solutions, powders, oils, ointments, and vapors or fumes.

ANTISEPTICS IN GENERAL USE

For convenience, all forms of antiseptics in use will be considered together, as well as those especially in use for sterilizing in surgical work. The following are the principal antiseptics in common use.

Bichlorid of Mercury or Corrosive Sublimate (*Hydrargyrum Chloridum Corrosivum*).—A white, highly poisonous powder, soluble in cold water, precipitated by the action of chlorid of sodium on the bisulphid of mercury. This is the most constantly used antiseptic in surgical work, but presents certain disadvantages, as follows:

1. It is inert in the presence of *albumins* or of *alkalis:* it is, therefore, (*a*) not a perfect disinfectant for organic secretions, such as excreta, etc., and (*b*) it is useless if mixed with soap, as for cleansing purposes.

2. It does not penetrate oily substances: to act, therefore, on the skin, all grease must first be removed.

3. On raw surfaces it is to some extent an irritant; it is considered to destroy cells and promote exudation, thus indirectly lessening resistance to infection; many surgeons, therefore, do not use bichlorid of mercury for clean wounds.

4. Unless very highly diluted it is too irritating for delicate tissues, such as the serous membranes and the conjunctiva.

5. Mucous membrane surfaces are made dry and rigid by solutions of the usual strength. It is not, therefore, suitable for douching in obstetric cases, where the parts must be kept flexible and lubricated during parturition.

6. If too freely absorbed through the tissues, it causes mercurial poisoning.

7. It stains white materials yellow, discolors paint, and to some extent corrodes metal, wood, marble, and porcelain.

8. In many persons the constant external use of bichlorid of mercury produces a skin eruption difficult to cure.

The action of bichlorid of mercury in the presence of albumin, which is constantly present in all organic tissues, excreta, etc., is to coagulate the albumin, thus forming a covering impenetrable to the disinfectant, inside which bacteria can live. This disadvantage is overcome by the addition of common salt, chlorid of ammonia, or some simple acid, such as tartaric acid. The "*bichlorid tablets*" in common use contain 7.3 of corrosive sublimate and the same amount of chlorid of ammonia. One tablet dissolved in one pint of water makes a solution of bichlorid of mercury 1 : 1000.

The average strength in which bichlorid of mercury is used is as follows:

For sterilizing china, glass, etc., where steam is not used	1:500.
For disinfecting the skin	1:1000 to 1:2000.
For dressing and cleansing infected wounds	1:2000 to 1:3000.
For vaginal douching and disinfecting mucous membrane surfaces	1:4000 to 1:5000.
For irrigation of sensitive membranes, such as the conjunctiva, urethra, etc.	1:10,000 to 1:40,000.

Bichlorid of mercury in a strong solution (1 : 500 to 1 : 1000) is frequently used to destroy pediculi that infest the human hair.

Carbolic acid, or **phenol,** is a coal-tar derivative, obtained as crystals which become liquefied on the addition of 5 per cent. cold water; the liquefied crystals are known as *pure carbolic acid.*

Pure carbolic is not used unless as a local application in the treatment of badly infected wounds. If the wound is extensive, the application is usually followed in a few minutes by a washing with alcohol, which arrests the action of the acid. For ward use the standard solution of carbolic acid is usually 1 part carbolic in 20 parts water, familiarly referred to as "one in twenty."

As carbolic acid does not stain linen, discolor paint, or injure wood or metals, it is a good disinfectant in many circumstances. In common with other acids it will, however, injure marble. On account of its poisonous

properties it cannot be used in dressings where the surface is extensively denuded, as in burns and scalds, since poisons may be absorbed through the broken skin.

The oily liquid of pure carbolic acid does not mix readily with water. It should be shaken in a bottle or stirred until entirely dissolved, otherwise any tissue coming in contact with the pure carbolic will be burned. Should a burn be caused in this way, the area should be immediately washed with the antidote, alcohol; care must also be taken to use neither oil nor ointment in the immediate dressing of such a burn, since oils aid in the absorption of the carbolic acid. Salt solution or a sterile dusting-powder is the dressing generally used.

The average strength in which carbolic acid solution is used is as follows:

For instruments and hardware..................	1:20.
For the skin and for linen and clothing..........	1:40 to 1:60.
For vaginal douching or in dressing of wounds...	1:80.
For sensitive membranes, conjunctiva, etc.......	1:100 or weaker.

In isolating an infectious case a sheet wrung out of carbolic acid 1 : 20, and kept well sprinkled with the same, may be hung across the doorway, and arrests the passage of germ-laden dust to the rest of the house.

Carbolic acid acts to some extent as a local anesthetic. Its use as a disinfectant for the hands causes frequently an unpleasant numbness. This property makes it a soothing application for such skin affections as urticaria, the rash of poison ivy, etc.

Carbolic crystals may be vaporized by placing them on a heated metal plate over a lamp, or by wrapping them in brown paper and setting it alight; in this way they are sometimes used to disinfect the air of a sick-room. Bowls of carbolic acid solution placed about a sick-room act also to a limited extent as a disinfectant.

On account of its irritating properties on the tissues and of its ready absorption into the system, carbolic acid is not commonly used for wounds or for mucous membrane surfaces. For the latter use two other coal-tar derivatives are generally preferred, *lysol* and *creolin*.

Lysol is obtained by the action of nascent soap on cresol, a derivative of carbolic acid. Mixed with water, it forms a soapy liquid. This makes it peculiarly useful for douching, especially in obstetric work, as it also acts as a lubricant. It is used for vaginal douching and for the hands in a solution of 1 to 2 per cent. For infected conditions, 3 per cent. solution is generally used.

Creolin is an emulsion of cresol, and has high antiseptic value; it is also a deodorant, and to some extent a hemostatic. Mixed with water, it forms a milky solution. It is a popular antiseptic in the treatment of infectious wounds, and as a rectal disinfectant in a solution of 1 to 2 per cent. Creolin is the antiseptic generally preferred in rectal surgery. Gauze which in preparation has been saturated with creolin (5 to 10 per cent.) is also used in surgical dressings.

Boric acid or **boracic acid** (*acidum boricum*) comes in white crystals, generally obtained by the action of sulphuric acid on borax. The crystals are soluble in 25 parts of cold water or in 3 parts of hot water. It is a mild antiseptic, non-irritating to the tissues, and, therefore, preferred for delicate or specially absorbent tissues, or where large areas are denuded. It is the antiseptic generally used in the treatment of the eye, ear, nose, mouth, and bladder. The dry powder mixed with an equal quantity of talcum or starch powder is used as a dusting-powder for broken surfaces.

A saturated solution of boric acid in water has a strength of 4 per cent., or 1:25. The saturated solution diluted with an equal quantity of water, making a solution of 2 per cent., or 1 : 50, is the usual strength preferred for douching, irrigating, etc.

Hydrogen peroxid or **solution of hydrogen peroxid** (*aqua hydrogenii dioxidi*, a watery solution of the dioxid of hydrogen) is greatly in favor at the present day for the cleansing of suppurating wounds and in the treatment of infected conditions of the throat, mouth, etc. When brought in contact with a suppurating area, oxygen is set free and an effervescence produced, which has the effect of carrying off dead tissue and inflammatory products. It

is considered to act by destroying the food on which bacteria live. Usually it is diluted to half its strength with sterile water, or, if used as a throat spray or mouth-wash, with lime-water. In cleansing a wound a small quantity is taken in a glass syringe and injected into the cavity. Peroxid of hydrogen is not suitable for douching or the irrigation of large surfaces. It should also be remembered that the volume of gas liberated is considerable, and for this reason peroxid of hydrogen must be used with caution in irrigating sinuses or deep wounds not well open to the surface. It is inactive and, therefore, ineffective as an application on the unbroken surface.

Permanganate of potash (*potassii permanganas*) occurs as royal purple crystals, soluble in 16 parts of cold water. As a saturated solution it is used in disinfecting the hands and skin by the Kelly method (p. 448). As a deodorizer and mild antiseptic it is used in irrigating offensive wounds and cavities, in strength of from 1 to 5 per cent. As the crystals are readily carried about, permanganate of potash is a popular antiseptic for douching, etc., in district work. Vessels containing a strong solution of this disinfectant may be set about a sick-room to neutralize offensive odors.

Alcohol, *absolute alcohol,* containing 99 per cent. pure alcohol to 1 per cent. water, is not used except for pharmaceutical or laboratory purposes. *Pure alcohol* is 94.9 per cent. pure ethyl alcohol by volume, with 5.1 per cent. water. For surgical use a solution of 70 to 75 per cent. alcohol in water is considered sufficient and by many preferred, as less readily causing coagulation of albumins, which to some extent limit the utility of alcohol as a disinfectant. Alcohol is used in surgery to preserve organic material, such as catgut, or specimens of organic tissues, in the sterilization of fine needles and delicate knives after boiling for thirty seconds, and for the removal of fat and grease from the skin before bichlorid of mercury is applied (see above). For this latter purpose *ether* is also used. *Proof spirit,* equal parts of alcohol and water, or *dilute alcohol,* about 48 per cent. alcohol in water, are used in nursing, chiefly in giving alcohol rubs and not for purposes of disinfection.

Iodoform.—Iodoform is obtained as fine yellow crystals, precipitated by heating iodin with potassium carbonate, alcohol, and water. The crystals have a characteristic permeating odor, very disagreeable to most people. Iodoform checks the growth of bacteria by the formation of iodin, which takes place when iodoform comes in contact with the secretions from wounds. The action of the iodin also stimulates the growth of fibrous tissue, so important in the healing of the sinuses and cavities of tubercular lesions. From this property it has its chief use in the treatment of tubercular wounds. Iodoform is used as a dusting-powder for raw surfaces, as an emulsion, usually with glycerin, in the treatment of tubercular sinuses, or as a dressing in the form of iodoform gauze. In rectal lesions, especially also those of tubercular origin, it is applied in the form of a suppository or as an ointment.

Like peroxid of hydrogen, iodoform is active only in contact with wound secretions. In its dry state, in common with other dusting-powders, iodoform should be sterilized before using, as it may become contaminated by bacteria (p. 472).

Iodin, tincture of, as a dressing for wounds, either clean or infected, and for use in the preparation of the field of operation (p. 450), became popular in the field surgery of the late war. Iodin checked bacterial development and stimulated the growth of fibrous tissue; it also reduces secretions.

The usual strength is a 7 per cent. solution; this is used full strength in cleansing infected wounds and diluted three-fourths as a dressing.

Acetanilid (*acetanilidum*), a carbon compound, is used to some extent, in the form of fine white crystals, as an antiseptic dusting-powder for raw surfaces, to stimulate indolent secretions. It should be used with caution, especially with children and feeble persons, as it is quite apt to be absorbed from the broken surface, producing dangerous collapse.

A compound antiseptic dusting-powder with stimulating properties is composed of equal parts of boric acid powder,

bismuth subnitrate, and calomel. It is familiarly known as B. B. C. powder.

Blue stone, or **sulphate of copper** (*cupri sulphas*), and **nitrate of silver stick,** or **lunar caustic** (*argenti nitras fusus*), are used as local applications to wounds, to stimulate indolent granulations, and to destroy those that are redundant. They also possess antiseptic properties. For delicate membranes, such as the conjunctiva, a milder form of the silver stick is used, known as *mitigated* silver stick. A **solution of nitrate of silver** in water, 2, 4, and 8 per cent., is also used, especially in the treatment of ulcerated conditions of the mucous membranes, in purulent ophthalmia, and in many infected conditions of the throat. Nitrate of silver is a true germicide.

Argyrol (*silver vitellin*) and **protargol** (*silver protein*) are silver compounds, discovered in recent years, which to some extent replace nitrate of silver as an application. They are considerably less irritating to the tissues, but do not possess the true germicidal quality of silver nitrate.

Common salt in water is used as a local antidote if necessary. The action of these applications is strictly local. A shallow slough forms at the point of contact, which, on separating, should leave a healthy granulating surface.

Normal Salt Solution.—A solution of common salt in water is so called because the proportion of salt in the fluid is the same as that in the blood. It is in common use at the present day as a substitute for irritating antiseptics, its action being mildly antiseptic and stimulating. In this respect it may be used in dressing wounds where the surface is extensively denuded, as in burns, in douching or irrigating the bladder, vagina, or rectum. Some surgeons use it in operations involving the serous membranes, especially in irrigating the peritoneal cavity. For these purposes it is preferable to plain sterile water, which has a macerating effect on the tissue. The most important use, however, is to restore fluid to the body after hemorrhage, etc., or as general stimulant in conditions of lowered

vitality. (See Enemata, Hypodermoclysis, Intravenous Infusion.)

The standard strength of normal salt solution at the present day is $\frac{9}{10}$ of 1 per cent. that is, 9 in 1000, or nine grams of salt to the liter of water ($2\frac{1}{4}$ drams to the quart). Formerly the standard was $\frac{6}{10}$ of 1 per cent.

In making the solution sterile filtered water and common table-salt are used. The solution is filtered through filter-paper into sterile glass flasks, free from the least speck of dust or foreign particles. The filtering is repeated until not the smallest sediment can be detected. The flask is filled two-thirds full and plugged with sterile cotton bound securely into place with a bandage, which serves also to prevent dust settling on the rim of the flask. The solution is then sterilized either in the autoclave or by boiling by the *fractional method.*

Whitewash, or **milk of lime,** made by mixing one part of slaked lime in four parts of *cold* water, is frequently a convenient domestic disinfectant, especially for the walls of dwellings in which infectious maladies have occurred. It is also used as a disinfectant for the excreta (see below).

Milk of lime is best freshly made: at most it should not stand more than two days.

Chlorin, a non-metallic element obtained from sea-salt, is a greenish-yellow gas with a penetrating, pungent odor, highly irritating to the mucous membrane of the air-passages. It has powerful antiseptic properties. As a gas, it is used to a limited extent in disinfecting dwellings (see below). Chlorin is soluble in water in the proportion of 2 parts gas to 1 of water: it forms the antiseptic principle in chlorinated lime and Labarraque's solution.

Chlorinated lime (incorrectly known as *chlorid of lime*) is a white salt, formed by the action of chlorin on slaked lime. A solution of the salt in *cold* water is used for disinfecting purposes. In mixing, a wooden vessel should be used, on account of the strong corrosive action of the mixture. The solution is used in two strengths. For the disinfection of excreta (see below) one pound is mixed

with one gallon of water (10 per cent.); for other purposes the strength is 6 ounces to the gallon (3 per cent.), sometimes known as "American standard." The latter is used in the disinfection of closets, sinks, garbage-cans, etc. Chlorinated lime is irritating to the tissues and destroys fabrics; its uses as an antiseptic are, therefore, limited. If no better disinfectant is available for the disinfection of clothing, the solution (3 per cent.) should be strained, and the clothes rinsed in cold water after they have been immersed in the disinfectant not more than four hours. In combination with carbonate of soda a paste of chlorinated lime is used by some in the surgical preparation of the hands (p. 449).

Labarraque's solution, or **solution of chlorinated soda,** is a greenish-yellow liquid with a mild odor of chlorin; its composition is sodium carbonate 10 parts, and chlorinated lime 8 parts, in 100 parts of water. It is also used in the disinfection of closets and sinks, etc. In ward work it is often found useful in removing stains from bath-tubs, sinks, and glassware. It is too destructive to be used in disinfecting fabrics.

Formaldehyd, a gas obtained by the oxidation of wood-alcohol, has powerful antiseptic and germicidal properties. A 40 per cent. solution of the gas in water is known as *formalin.* A 4 per cent. solution of formalin in water is considered to equal in antiseptic value a 1:1000 solution of bichlorid of mercury or of 1:20 carbolic acid. Cold water is used in making formalin solutions, as the gas is given off if heated. Formalin injures metals to some extent, but at the present day is a popular disinfectant for linen, clothing, utensils, rubber goods, and all kinds of hardware (furniture, etc.). A 2 per cent. solution is generally used. The vapor is highly irritating to the air-passages and to the eyes, which to many is an objection to its use.

Other antiseptics are not in general use, but are frequently met with in surgical work and preferred by certain surgeons.

Harrington's alcoholic solution of bichlorid of mercury is frequenty used in the preparation of the skin and for disinfecting glass, china, or enamelware by immersion.

The formula is:

Bichlorid of mercury	1.5 gm.
Hydrochloric acid	100 c.c.
Glycerin	100 c.c.
Alcohol, 95 per cent	1200 c.c.
Distilled water	2000 c.c.

Ringer's Solution.

Iodin chlorid	150 oz. Troy.
Calcium chlorid	2 oz. "
Potassium chlorid	1 oz. "
Distilled water to 5 gallons.	

It is used undiluted.

Dilute 4 ounces of the solution with 28 ounces of distilled water; filter through filter-paper into sterile flasks; plug with sterile absorbent cotton and sterilize by boiling twenty minutes. It is used in preparing the field of operation, especially in emergency work, in place of alcohol or corrosive sublimate.

Thiersch's solution is made of boric acid, $1\frac{1}{2}$ ounces, salicylic acid, 2 drams, to 1 gallon of hot water. The solution is sterilized before using. It is used chiefly for douching and irrigation in place of boric acid solution.

A. B. C. antiseptic douche contains alum, 1 ounce, boric acid, 4 ounces, carbolic acid crystals, 3 drams, and oil of peppermint, $1\frac{1}{2}$ drams. One dram of the powder is used in one pint of water. It is used chiefly in gynecologic work as an antiseptic vaginal douche.

Precautions.—It must be remembered that practically all disinfectants are highly poisonous, and care must be taken to prevent accidents in their use. The bottles in which they are put up are usually of dark glass, and ribbed as an additional precaution; they should always carry a poison label in a prominent part.

In hospital work it is often the custom to color the solutions commonly used with one or other of the anilin dyes. Thus, bichlorid of mercury may be lavender, carbolic, blue, and so forth. This is a specially useful precaution with those antiseptics that are placed about a ward in basins, as hand lotions, or used in the sputum-cups.

DISINFECTING A ROOM

The vapors or gases of certain disinfectants are also used for purposes of disinfection, more especially for dwellings, furniture, bedding, and clothing.

Formaldehyd.—Of all, the most popular germicide at the present day is formaldehyd. As a general disinfectant for a sick-room or ward after an infectious case it is unrivaled. Several methods are used:

1. The gas may be liberated from the solution by *heat* in a special apparatus designed for the purpose. The apparatus stands outside the hermetically sealed room, and the gas is introduced through a fine tube which fits into the keyhole (Fig. 150).

Fig. 150.—Formaldehyd fumigator.

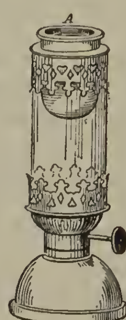


Fig. 151.—Apparatus for generating formaldehyd from tablets of polymerized formaldehyd: *A* indicates the cup in which the tablets are placed (Abbott).

2. Formaldehyd tabloids are vaporized by being heated

on a metal plate over a special lamp designed for the purpose (Schering's lamp). The lamp is placed inside the closed room. To prevent risk of fire, the lamp should be placed on an inverted plate or tray, in a basin the bottom of which contains some water.

3. A simple method is to wring sheets out of a solution of formalin, 10 per cent., and hang them on screens or clothes'-lines about the room, which is then hermetically closed.

4. Formaldehyd may be liberated by combining 4 ounces of formalin (40 per cent.) with 1 ounce permanganate of potash crystals. This liberates a sufficient volume of gas to disinfect a space of 1000 cubic feet. For each additional 1000 cubic feet a similar quantity is added.

A pail or tub large enough to hold at least 5 gallons of water is necessary, as the combination of the two ingredients causes the mixture to boil up violently. Some device must be used to retain the heat thus generated, without which the gas will not be liberated. The vessel may be covered with asbestos, or old blankets may be secured round it. The vessel must be placed where it will not upset, and the floor round should be protected. The fumes of formaldehyd are exceedingly irritating. If it is absolutely necessary to enter a room filled with formaldehyd, the gas may be precipitated by sprinkling ammonia water freely about the room.

Sulphur.—Sulphur, in the form of candles, powder, or rock sulphur, was in earlier days burnt as a disinfectant for rooms, clothing, and furniture. It is now considered of little value as a germicide. It has one valuable property, however: the fumes destroy insect life. Sulphur fumigation is a reliable method of destroying bedbugs.

Five pounds of sulphur are required for every 1000 feet of cubic space. The powdered sulphur is heaped in an old iron plate or flat basin, which should be raised on a couple of bricks in a tub or wide basin containing water, in order to avoid risk of fire. The tub should stand on three bricks placed evenly on the floor. The sulphur is wet with a little alcohol, which is lighted when all the preparations are made.

The fumes of sulphur will discolor metals and any gilding on decorations.

Chlorin.—Chlorin gas may be liberated in the following way, and is sometimes used in disinfecting rooms:

Mix 2 drams of common salt and 2 drams of black oxid of manganese; place in a saucer, and add ½ ounce strong sulphuric acid diluted one-third with water. Enough chlorin is liberated to disinfect a space of 32 square feet (L. L. Dock).

To ascertain the number of cubic feet in a room, multiply the length by the breadth, and the result so obtained by the height. For example:

Length		Breadth				Height		
20 feet	×	15 feet	=	300 feet	×	10 feet	=	3000 cubic feet.

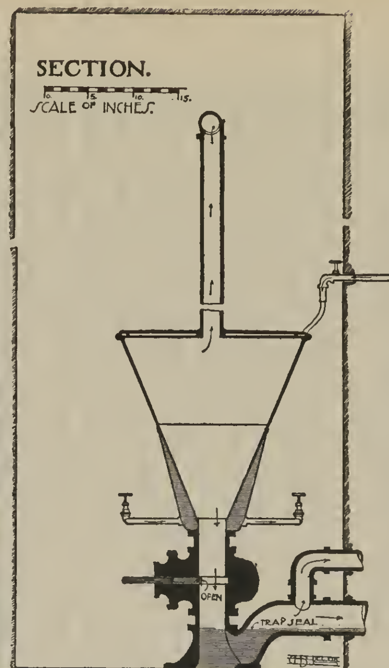
In **preparing a room for disinfection** all the furniture is arranged so that every part is exposed to the fumes. Drawers and doors of closets should be wide open and emptied of their contents. Clothing, linen, etc., should be hung about the room on screens or improvised clothes-lines. The window-shades should be drawn down. All chinks in doors or windows should be stuffed with tow, old cloths, or pasted over with strips of newspaper. The radiator must be closed, and if there is an open chimney, it must also by some means be stopped up, preferably with a closely fitting board.

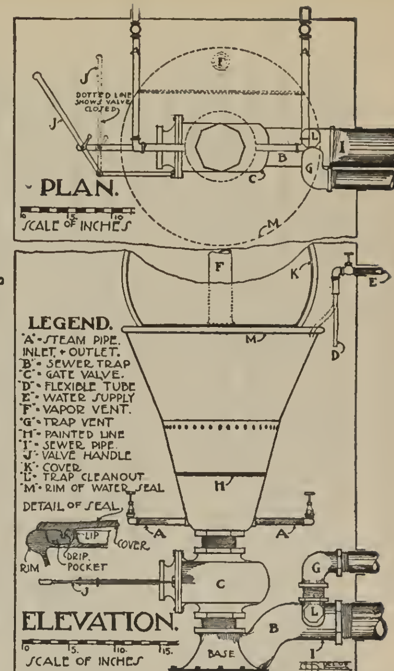
When all is ready, the disinfectant is started, and the door immediately closed, the keyhole and door chinks being also stuffed up. Nurses have been known to use adhesive plaster for this purpose: the extravagance of such a proceeding has only to be pointed out.

The room is left closed for from twelve to twenty-four hours, after which fresh air and sunlight are freely admitted and every available part of the room and the furniture thoroughly cleaned with soap and water.

DISINFECTION OF EXCRETA

The proper disinfection of the excreta is an important part of a nurse's duties in those infections where the bac-





Figs. 152, 153, 154.—Sterilizing hopper for the safe disposal of infectious excreta in hospitals. When infectious discharges are to be sterilized the gate valve is closed. Through the rubber hose at the right water is turned on for washing of utensils, and is allowed to enter the hopper to the line H. Steam is then turned on through the steam inlet. Boiling takes place almost immediately, and after five minutes' boiling the gate valve is opened to allow the contents to escape, and the hopper is flushed by means of the hose attached to the faucet. (Aikens.)

teria of the disease are present in the excreta, as in typhoid fever, cholera, and dysentery.

Chemical disinfection is attained by mixing the stool (or urine, sputum, etc.) thoroughly with a strong, antiseptic solution. In many hospitals bichlorid of mercury (1:1000) or carbolic (1:20) are used. We saw, however, that these were not perfect disinfectants for organic secretions, their tendency being to coagulate the albumin and thus arrest the action of the disinfectant on the bacteria inclosed in the albuminous capsule. To be effective, an equal quantity of the disinfectant must be stirred into the stool and set aside for several hours in a closed vessel; as a rule, this is not practical. Formalin (2 to 4 per cent.) is, on account of its volatility, also not an ideal disinfectant for the purpose. Chlorinated lime (10 per cent.) is, on the whole, considered the best chemical disinfectant for excreta. An equal quantity of the solution should be thoroughly mixed with the stool, and allowed to stand fifteen minutes before being emptied down the soil-pipe. The vessel should be covered meanwhile with a cloth wrung out of bichlorid of mercury (or other disinfectant).

Boiling.—In some hospitals a special hopper in which stools and urine are sterilized by boiling is used. The hopper is connected with a steam pipe; some water is mixed with the stool in the hopper, the hopper closed, and the steam turned on. The stool is allowed to boil, usually for five minutes, then the steam is turned off, the valve connecting the hopper with the soil-pipe opened, and the hopper flushed as in an ordinary water-closet.

In **country districts** where there is no water system the stool may be emptied into a covered pail and mixed with a generous allowance of freshly made whitewash or with chlorinated lime, and the whole buried in some spot away from the habitation and *at a safe distance from all possible contamination of any water-supply.*

In the camp hospitals of the late war the stools were destroyed by burning, an ideal method where large numbers are assembled in primitive sanitary conditions.

The vessel which has contained an infectious stool should also be disinfected immediately after use. In

modern hospitals medical wards are usually provided with a sterilizer in which bed-pans, urinals, and sputum-cups can be sterilized by steam. Where this is not the case, they may be kept, after being cleaned, soaking in a tank filled with a disinfectant, usually bichlorid of mercury (1:1000) or formalin (2 per cent.).

MEASURING SOLUTIONS

Disinfectants, lotions, etc., are usually sent to the wards in concentrated solutions, to which water is added to dilute them to the required strength. Practice is necessary to teach nurses to reckon the percentages accurately.

Metric System.—The simplest and most accurate method is to employ the metric system. The percentage is then easily understood, as so many grams (solid) or cubic centimeters (fluid) in each 100 cubic centimeters of water. To find the total amount it is only necessary to multiply the percentage by the number of hundred cubic centimeters required: thus, to make 500 c.c. of a 2 per cent. solution, multiply 2 by 5, and we find we shall want 10 c.c. or 10 grams of the drug. Similarly, 1 in 20, 500, or 1000 signifies one gram or cubic centimeter in each 20, 500, or 1000 c.c. of water.

Apothecaries' Measure.—In using the apothecaries' measure the proportion is most easily found by using the ounce as the basis of measurement. The ounce contains 480 minims; for practical purposes, in making up antiseptics in the large bulk in which they are used, it is usually considered sufficient to consider the ounce as a measure of 500 minims. The amount of the drug required in each ounce is then readily found by multiplying the percentage by 5.

Thus: 1 per cent. requires 5 grains or minims in each ounce; 5 per cent. requires 25 grains or minims in each ounce; 10 per cent. requires 50 grains or minims in each ounce, and so forth.

Where the percentage is expressed as 1 in 20, 25, etc., one part of the drug is allowed in every 20, 25, etc., of the whole quantity, whether minims, drams, ounces, or pints.

Solutions of which the percentage is reckoned in thou-

sands (1 : 1000, etc.) may be prepared by, in the first place, adding to each ounce (500 minims) one grain or one minim of the drug. We have then, as a basis, a solution of the strength of 1: 500, which can be diluted to the required strength by adding sufficient water.

To find the amount of water to be added to a solution of known percentage in order to make a solution of a weaker strength, divide the strength required by the strength of the original solution and subtract one (*i. e.*, one part) from the answer.

For example, to make 1: 3000 from 1: 500—3000 ÷ 500 = 6 − 1 = 5.

The division shows we want a solution one-sixth the strength of the original; we make this by taking five parts water and one part of our original solution.

In **mixing solutions** from the crude drug, warm, not hot, water should be used, except for carbolic acid, boric acid, and normal salt solution, which are more thoroughly and quickly dissolved in boiling hot water. Cold water is used in making solutions of alcohol, formalin, and preparations of lime. Cold water is also used (5 per cent.) to liquefy the carbolic crystals.

The bottles used should be clean and sterile, and provided with glass stoppers instead of the ordinary cork, which is an absorbent material.

Before pouring a solution nurses should be taught to wipe the rim of the bottle with a gauze sponge soaked in a little of the solution to remove any dust that may adhere.

CHAPTER XIII

PREPARATION AND STERILIZATION IN SURGICAL WORK

The Hands—Field of Operation—Instruments—Rubber Vessels—Sutures and Ligatures: Catgut, Plain, Iodin, Formalin, Chromicized, Cumol—Dusting-powders—Oils and Ointments—Dressings—Sea-sponges—Brushes—Cultures.

In carrying the principles of asepsis into practice at an operation or a surgical dressing, we have two points to consider:

1. The preliminary preparation of all things to be used which may be channels of infection.

2. The methods by which, at an operation or dressing, they are so handled as to insure their remaining "*sterile.*" The object of either is, first and last, the prevention of *infection* or bacterial invasion of the wound.

Under the first heading we must consider the preparation of the hands of the operator and of those concerned in assisting him, and of the field of operation, the sterilization of instruments, ligatures, sutures, dressings, and appliances.

The following are the methods accepted at the present day in the leading American hospitals, and, with some modifications, are in practically universal use.

THE HANDS

The most important part of any preparation involving the skin is a preliminary scrubbing with hot soap and water, using a small scrub-brush whenever possible. This is especially important in the preparation of the hands. In operative work the so-called preparation of the hands includes always the forearms to a point above the elbow.

Liquid green soap or tincture of green soap (an alcoholic preparation of green soap) is usually preferred; it can be sterilized and kept in sterile flasks. A hand-brush and

nail-cleaner, sterilized since last used, should be provided for each person. The water should be changed at least twice during the process; unless the water in the pipes is actually sterile, it is not usually practical to provide sterile water for the mechanical part of the preparation of the hands; it should, however, be carefully filtered.

The preliminary scrubbing should be invariably carried out by the clock. Thus:

1. Scrub arms to elbows in a lather of soap and hot water one minute, then hands two minutes, using a brush and paying particular attention to the inside of the fingers; rinse in running water—change the water.
2. Clean the nails and remove loose epithelium round the nails with the nail-cleaner. (Any one actively engaged in surgical work should keep the nails very short.)
3. Scrub vigorously with the brush five minutes.

The preliminary scrubbing effectively carried out, there are two or three methods of chemical disinfection in general use. In many hospitals the hands and forearms are immersed in alcohol, 75 per cent., unheated, for two minutes. Solutions used should be contained in sterile basins of sufficient size and depth to allow the arms to be immersed.

Schatz method, also known in America as the **Kelly method:**

1. After scrubbing as above, immerse in a saturated solution of potassium permanganate until the skin is brown.
2. Immerse in a saturated solution of oxalic acid until the color is removed.
3. Rinse in sterile lime-water to neutralize the acid.
4. Immerse in bichlorid of mercury 1 : 1000 and scrub the skin briskly for a full minute.

A modification of this method, omitting the lime-water bath, is in common use.

Fürbringer Method.—1. After scrubbing as above, immerse in alcohol, 75 per cent., unheated, for one minute, rubbing the skin briskly to remove the superficial epithelium and fat.

2. Repeat the process in bichlorid of mercury (1 : 1000) for three minutes.

Weir or Stimson Method.—1. After scrubbing as above, make a paste of equal parts of chlorinated lime and carbonate of soda, with cold sterile water. Rub the paste into the skin of the hands and forearms for five minutes.

2. Rinse in sterile water.

3. Wash in weak solution of ammonia water to neutralize the odor of chlorin.

Once the hands have been sterilized, care must be taken that they come in contact with nothing unsterile. Nurses should be taught to hold their hands after "scrubbing up" with the elbows acutely flexed and the hands on a level with the shoulder. This keeps the hands out of the way, and the position is a reminder of the care to be exercised.

THE FIELD OF OPERATION

On account of the irritation to the tissues the field of operation is not prepared more than about twelve hours before the operation. Almost all surgeons at the present day prefer no preparation other than washing with soap and water, shaving when necessary, until the patient is on the table.

In preparing the field, a wide area is scrubbed with soap (tincture of green soap usually) and hot sterile water, using, wherever possible, a hand scrub-brush, and shaved with a sharp razor and a good lather. At least five minutes should be given to the scrubbing. The scrubbing over, the soap is removed with hot water and the area washed with alcohol and then ether (some omit the ether), in order to remove all grease and débris of superficial epithelium and to prepare the way for the disinfectant. Finally, the surface is freely flushed with a hot solution of bichlorid of mercury, 1 : 2000.

Nurses should be taught to use sponges for the alcohol and ether washings and not to flush the area from the flasks, a practice that is quite unnecessary and very extravagant.

In those cases of abdominal section where there is local tenderness or distention, preparation of the area is usually postponed until the patient is under the anesthetic. If

it is carried out, it must be done with extreme gentleness, using sponges only and no brush.

Some gynecologists use Kelly's process of skin preparation for abdominal sections, using sponges in place of the immersion. Great care must be taken that the oxalic acid is completely removed, and that none is allowed to escape and run down the patient's back, where it will irritate and possibly burn the skin.

In emergency work a solution of tincture of iodin is often used for the skin preparation, and is also favored by some surgeons in general surgery. A 7 per cent. solution of iodin in alcohol is used (adults) for septic and emergency cases, a three-quarter strength of 7 per cent. for clean cases. Benzin is applied before the iodin to prevent burning. The iodin is removed after the operation by alcohol.

The skin preparation should be carried out with the same care in preparing an area for minor operations, such as exploration, aspiration, hypodermoclysis, etc.

A minimum preparation is permitted in giving hypodermic injection of medicines. *Provided that all that is to be used is sterile*, it is considered sufficient to wash a small local area with alcohol (p. 319). The puncture is so fine that it practically closes as soon as the needle is withdrawn.

In preparing the field of operation, the preparation should also include a generous portion of the surface in the vicinity of the proposed incision. In determining the area to be prepared for various operations the following list is compiled from the instructions issued to the nursing staff of Johns Hopkins Hospital, The Pennsylvania Hospital, Philadelphia, and the Philadelphia Polyclinic Hospital.

Abdominal Cases.—From the nipple to the knee, and from the bed-line on either side. Shave the pubes and the abdominal wall from the umbilicus four inches on either side the median line.

Stomach.—From the clavicle to the pubes, and from the bed-line on either side.

Kidney.—From sternum to spine on the affected side, and from axilla to hip.

Breast.—From the hair-line and ear to the waist-line; from the nipple on the opposite side to behind the shoulder of the affected side; the arm to the elbow and the axilla of the affected side, shaving the axilla.

Glands of Axilla.—From the sternum to the spine on the affected side, and from neck to waist; the arm to the elbow, shaving the axilla.

Glands of Neck.—Hair-line (above, if the glands are high) to nipple; axilla and shoulder on affected side, shaving the axilla; the arm to the elbow.

Brain.—Shave the whole head, prepare the skin of the head and neck.

Limbs.—Shave and prepare well above and below the affected part.

Nurses may have to be warned against shaving where it is unnecessary. A razor should never be used on the face, neck, breast, or arm (except the axilla) of a woman without distinct orders. When an area has been shaved, the hair is always apt to grow in again more strongly, which may be disfiguring. An eyebrow is also not to be removed without definite instructions.

Vagina and Cervix.—Place the patient in the lithotomy position. Shave the labia and lower half of pubes; prepare the external genitals, covering the area from the pubes to the bed-line; continue the preparation to the inner surface of the thighs and buttocks, about eight inches on either side. Cover the genitals with a large sterile perineal pad applied with a T-bandage.

A hot antiseptic douche (bichlorid of mercury 1:5000, boric acid, 2 per cent., or lysol, 2 per cent. is usually ordered as part of the preparation.

Some gynecologists order the vagina washed with soap and hot water before the douche. The patient lies in the lithotomy position, the vagina held open with a Sims speculum; the cleansing is done with gauze sponges on long sponge-holders. This preparation is usually postponed until the patient is under ether.

The Rectum.—Shave in the vicinity of the anus, and prepare the buttocks and inner surface of thighs about eight inches on either side and to the bed-line (lithotomy

position). Cleanse the rectum by enemata of hot soap and water, repeated until the lower bowel is entirely empty. No dressing is applied.

An irrigation (such as creolin, 2 per cent.) an hour before the operation may be ordered, and in particular cases a medicated suppository may be necessary. This is a special order, and not part of the routine treatment.

The Mouth, Tongue, Palate, etc.—For some days previously an antiseptic mouth-wash is used two or three times a day. Usually peroxid of hydrogen, diluted with equal parts of lime-water, is the wash preferred. For major operations the mustache and beard are shaved. The teeth are previously put in order by a dentist.

The Nose.—For an operation of any extent on the nose the mustache is shaved and the face from hair-line to chin prepared in the usual way. A preliminary nasal douche of warm boric solution (2 per cent.) or other antiseptic may be ordered.

The Ear.—For minor operations on the auditory canal or the ear-drum cleanse the external ear and the auditory meatus, using for the latter small pledgets of cotton. Leave a pledget soaked in the antiseptic in the meatus. For mastoid operations shave and prepare half the head, and prepare face, neck, and upper half of shoulder on the side of the affected ear. Douching is not usually ordered.

The Eyes.—1. Wash the face from hair-line to lips with soap and water, and sponge with alcohol, taking care to keep the eyelids closed.

2. Hold the conjunctival sac well open and douche thoroughly with warm boric solution (2 per cent.) or with bichlorid of mercury 1: 10,000; boric is usually preferred, as mercury produces a dry, uncomfortable sensation. No force must be used.

3. Cover the affected eye with a sterile gauze pad, and over that place a gauze dressing to cover the face on the affected side.

The preparation is usually ordered about one hour before the operation.

Eye drops of atropin are frequently ordered as part of the preparation. (See Chapter IV.) They will, however,

be introduced at a specified time, and not necessarily at the time of the skin preparation. If both eyes are ordered to be prepared, or if neither is covered, the eye to be operated on should be indicated by some intelligible mark. One accident is on record where the wrong eye was removed, resulting in total blindness.

Skin-grafting.—In the preparation of a wound to be grafted (*i. e.*, to be covered over with living tissue) antiseptics are avoided, as they coagulate the albumin and to some extent destroy the vitality of the tissues.

The wound is usually cleansed with normal salt solution and covered with a wet dressing of the same.

The area from which the grafts are to be taken is prepared according to the usual formula, followed by a thorough washing with normal salt solution, and covered simply with a dry, sterile towel. After the preparation no antiseptics are used either in covering the area or during the operation. Many surgeons, indeed, omit the antiseptics also from the preliminary preparation, and order only a thorough cleansing with soap and water and flushing with normal salt solution.

The grafts are usually taken from the inner surface of the thigh. The whole of the inner surface is prepared.

Cauterization; Wet-cupping.—In preparing the skin for cauterization by the actual cautery or for wet-cupping neither alcohol nor ether is generally used, the reason being that, unless completely removed from all parts, such inflammable substances may readily ignite and cause a burn. The preparation is done immediately before the application.

Dirty and Infected Wounds.—The preparation of such depends on the extent and nature of the injury, and no special rules can be laid down. The area round the wound should first be cleansed, washing away from the wound; where necessary, as in scalp injuries, it must also be shaved. The wound itself is then first washed free of all dirt, using soap and water and flushing with sterile water, following which it is washed with a 7 per cent. solution of tincture of iodin and dressed with the same diluted to three-quarters the strength. (See p. 450.)

INSTRUMENTS

Instruments, except those with cutting-edges, are sterilized by boiling for ten minutes. To prevent spotting with rust, the water should be actively boiling at the time of immersion, and should completely cover the instruments. Bicarbonate of soda, 1 per cent. (about three level teaspoons to the quart), is frequently added to the water, also for the prevention of rust, but must be omitted if rubber or silk materials are boiled at the same time. Shot and safety-pins are boiled with the instruments—the shot in small muslin bags, the safety-pins, for convenience, strung six at a time on a safety-pin.

In hospital work the instrument sterilizer is a wide metal boiler filled with one or more trays on which the instruments are placed for sterilization, and on which they can be removed and carried to the operating-table without handling. In private work a fish-kettle makes an excellent substitute.

After use, instruments should at once be covered with cold water until ready to be cleaned; this is in order to dissolve the albumin in the blood-stains.

In cleaning, the steps are as follows:

1. Remove the blood-stains with cold water.
2. Place in boiling water and boil for ten minutes.
3. Scrub with hot water and Sapolio, Bon Ami, or similar soap.
4. Drain on a towel, dry thoroughly, rub up with a little alcohol.

Whiting, made into a paste with alcohol and ammonia, is sometimes used to polish plated instruments. Extreme care is then necessary to remove all traces of powder from joints and teeth. In many hospitals the use of paste is forbidden.

Scissors, forceps, needle-holders, and all shutting instruments should be open while being sterilized, and should be kept open while in the instrument closet, in order not to strain the spring unnecessarily. During operations it is, however, a convenience to string artery forceps (closed) together, six at a time on a safety-pin. This is generally allowed, provided they have previously been sterilized open since the last operation.

Sharp Instruments.—Boiling in water to a great extent blunts sharp instruments, such as knives, needles, scissors, etc., and their care is slightly different from other instruments in consequence. Before an operation knives may be immersed in boiling water for one minute and then laid in 5 per cent. alcohol for fifteen minutes, or in carbolic 1 : 20 for two minutes. At the present day many surgeons favor a preparation known as *Russian oil* in which fine cutting instruments are immersed and boiled for five minutes without danger of blunting the edges. After boiling they are wiped with a sterile sponge and used without immersion in alcohol or an antiseptic. After an operation knives are cleaned as above, sterilized according to the formula preferred, and sent to be sharpened.

Cutting instruments are protected when not in use by winding the blades with a fine strand of cotton; they should always be sterilized separately from other instruments.

Needles may be run through a piece of gauze for convenient handling; when not in use, they may be kept in covered glass boxes with a little emery powder to prevent rusting, or they may be put up in pairs between two folds of gauze, and a convenient number kept thus ready for immediate use in sterile, covered glass jars. Each jar should contain needles of only one variety.

Spots and rust-marks are removed from needles and blades with emery powder. A small board covered with flannel is kept for the purpose; the instrument is laid flat on the board and covered with emery powder and rubbed.

Delicate instruments, as cystoscope, urethrotome, etc., are spoiled by boiling. They may be sterilized in the autoclave or by soaking half an hour before use in alcohol, 5 per cent., in carbolic acid, 1 : 20, or in formalin, 2 per cent. Corrosive sublimate is never used for instruments. Where there are hinges or screw parts these should be oiled after cleaning.

Needles.—The different needles, and the purposes for which the varieties are used, should be taught the pupils in a demonstration class. For the skin and connective tissue, which are tough, resistant tissues, needles with

cutting-blades are used; for tissues that are easily torn and vascular, such as the kidney, intestines, cervix, etc., rounded needles, the point only sharp, more like the ordinary sewing-needle, are preferred; needles with flat blunt blades, the point only sharp, are used for suturing deep fascia without injury to the adjacent tissues; needles for superficial work are usually straight or semi-curved; those used for the deeper fascia are curved. Needles for the deeper facsia are mounted on holders, of which there are a large variety, almost every surgeon having some special preference in this respect. According to convenience, the eye of the needle may be at the blunt end or at the point. For the deeper fascia, where a holder is necessary, the eye is more frequently at the point. A few needles for special purposes are frequently made with their own handles; such are the needles used in operations for hernia (right and left), for cleft-palate, and for suturing the pedicle or stump in operations for removing the ovaries. An aneurysm needle is also mounted on its own handle; it is a flat, blunt, semi-curved blade, the eye at the point, used in transfixing blood-vessels, as, for example, in the simple operation of intravenous infusion. The needles are, as a rule, in charge of the nurse at an operation.

A card with a sample needle of each kind used in the hospital is a great help to the operating-room nurses; the card should show the name of the needle and a couple or so of cases for which the special needle is used. (Massachusetts General Hospital.)

Hollow needles, such as those used for hypodermic injection, exploration, aspiration, intravenous infusion, etc., require special care in cleaning and sterilizing to prevent the fine tube becoming clogged with rust or with coagulated albumin.

Invariably, *immediately after use,* they must be washed in *cold* water, which must run freely through the needle. If attached to a syringe, the water is drawn and expelled repeatedly through the needle. The wire must be passed through the needle repeatedly during the process, to help

in the removal of any deposit. When clean they are sterilized as above. Before putting away, the needle must be dried by briskly moving the wire in and out, drying it each time. When perfectly dry, the wire is inserted and kept in place. The wire must come well beyond the point of the needle in order to protect it. The hypodermic needles in constant use in the wards are conveniently kept in covered glass boxes with a little emery powder or fine shot, which keeps them free of rust.

Trocars and Cannulas.—Cannulas are cleaned with the same special care as hollow needles, but may be boiled for the full time, like non-cutting instruments. The trocar, being a sharp instrument, is sterilized according to the formula, the point being protected with cotton. Trocars and cannulas should be separate while being sterilized; a flexible probe is used in place of the trocar to clean the inside of the cannula.

Silver catheters must also be cleaned with minute care under *running cold water immediately* after use. The stilette is used like the wires of needles to clean and dry the inside, and is kept in place while the catheter is not in use, but is removed during boiling. Not being sharp instruments, catheters are sterilized by boiling the full time. No paste or powder should be permitted in cleaning catheters, as it is difficult to prevent it lodging in the eye. Scrubbing with hot water and Sapolio, followed by rubbing with a dry chamois leather, is sufficient to keep them bright.

Paquelin Cautery.—An instrument requiring a special process in sterilizing is the *Paquelin cautery*. The tips, which must be sterile, are made of hollow platinum (p. 105) and are readily indented when heated. After use, the tips should immediately be brought to white heat for one minute, in order to burn off any organic matter that may be adherent; they must then be allowed to cool slowly, in such a position that they will not be exposed to knocks or falls while soft. When thoroughly cooled, they may be washed, if necessary; usually rubbing with chamois leather is all that is required. The heating is adequate

sterilization. The same process is used in sterilizing the platinum wires used in taking cultures.

The **closet** in which instruments are stored should be dust proof. Those made of glass with a metal frame are the most easily kept clean. To prevent rust, a dish containing plaster-of-Paris, which absorbs moisture from the atmosphere, should be kept in the closet and renewed from time to time. The instrument cases made by the leading firms are provided with a barometer, so that the humidity of the air in the case can be gaged. For the same reason the closet should be in as dry a place as possible. It should not, for example, be exposed to steam from hot-water supply or the sterilizers.

Nurses should be taught to arrange the instruments in convenient groups, and invariably in the same order.

Syringes.—Glass syringes with a glass piston or with asbestos packing can be sterilized by boiling. The water must be cool when the syringe is first put into it or the glass will crack. With metal attachments and rubber washers boiling is impracticable. The syringe is then cleaned by drawing first cold water and then hot soap and water in and out of the syringe repeatedly, finally rinsing thoroughly. It is sterilized by drawing alcohol, 75 per cent., formalin, 2 per cent., or other disinfectant into the barrel and then placing the syringe in the antiseptic for half an hour, taking care that it is completely covered.[1] This is necessary if the syringe is to be used for exploratory purposes or for the administration of antitoxin serum. For ordinary use it is not necessary that the outside of the syringe should be sterile. If the washers have shrunk, they must be soaked in sterile water to swell them again.

The **air-pump** attached to an aspirating apparatus is sometimes mistaken for a syringe and ruined by having water drawn into the barrel. The air-pump cannot be thoroughly sterilized without spoiling it; for this reason when aspiration is performed the pump is worked by an "unsterile" assistant. (See Chapter XIV.)

[1] If the syringe is to be used for exploratory purposes or for antitoxin serum injections, alcohol is preferred to an antiseptic.

RUBBER

Prolonged exposure to heat destroys rubber; acids corrode it; if in contact with oil or grease, it becomes soft and partially dissolved; soap, on account of the grease, has also a deteriorating effect; while all rubber, if put aside, readily becomes dry and cracked. Rubber appliances, therefore, are extremely difficult to care for, and are, in addition, expensive items. Some general rules for their care are applicable to all rubber articles.

Do not use soap where it can be avoided; in scrubbing, use tepid water in place of hot, remove the soap quickly, and rinse very thoroughly in cold water.

Clean in *cold* water immediately after use if the articles have come in contact with organic matter. If boiling is necessary allow ten minutes, keeping the water actively boiling; use no carbonate of soda and protect from contact with the metal of the sterilizer by laying the articles on a folded towel; keep light rubber articles from floating by folding in a towel, or by tying loosely in a square of gauze and clipping to the little package a pair of artery forceps to act as a weight.

Each surface of the article to be cleaned or sterilized must be equally thoroughly cared for. Gloves and nipples must be turned inside out, and cleaned on either side. Tubing and catheters must have the water or solution run freely through them; this is most thoroughly done by attaching a funnel or the barrel of a glass syringe to one end, and holding under a spigot of running water.

Hard-rubber articles (catheters, nozzles, tracheotomy tubes, etc.) are temporarily softened by exposure to heat and lose their shape. To avoid this, if boiling is necessary, insert the stilette or a probe bent to the shape and keep it in place during boiling, and until the rubber hardens again on cooling.

Where chemical sterilization is preferred, immersion must be complete, and should be continued for a specified time, and no more. Alcohol, 70 per cent., formalin, 2 per cent., or corrosive sublimate, 1 : 5000 are the antiseptics usually preferred. After immersion rinse thoroughly in cold sterile water before putting away. Before use place in

alcohol, 70 per cent., for fifteen minutes or in a 2 per cent. solution of boracic acid.

Dry all rubber goods thoroughly before putting away, and keep in as cool a place as possible. In drying tubing, catheters, etc., stretch repeatedly to squeeze all moisture from the inside; dry gloves and nipples, etc., on both sides. In putting away, avoid all folding. Keep double surfaces apart, either by inflation (air-cushions and beds, etc.) or by keeping gauze or cotton between. An ice-bag, for example, not in use should be kept blown up and lightly packed with gauze. If the articles are out of use for any length of time, they should, when practical, be soaked from time to time in cold water.

Gloves of thin, flexible rubber are at the present day used during operations and for other surgical proceedings, such as dressings, and vaginal or rectal examinations, as they can be made more certainly sterile, and are more easily kept so, than the hands. Unless quite intact, they may be a source of danger, since they cause the hands to sweat and the sweat will readily ooze through any small opening.

Pricks and *cuts* are detected by holding the glove in a basin of water; as it fills under water, little air-bubbles will appear at any puncture, however minute. The punctures must be sought for and repaired with rubber cement after each use. Mended gloves can be used by the nurses or for ward dressings, but are not safe for operation, on account of the risk of the small patch becoming separated.

After use, blood-stains and all organic matter should be removed with *cold water while still wet*, after which each glove is scrubbed inside and out with tepid soapsuds, using a brush thoroughly, but lightly, and rinsed well in cold water. New gloves are treated the same way before use.

In sterilizing, some hospitals use the autoclave, especially for gloves that are to be used in operating. After cleaning, dry thoroughly, powder both surfaces freely with talcum powder, wrap in the usual double cotton covers, and sterilize with the dressings twenty minutes at fifteen pounds' pressure. In other hospitals gloves are sterilized

by boiling ten minutes, and have no other treatment beyond thorough cleaning.

For chemical sterilization clean as described, then place for fifteen minutes in alcohol 75 per cent., corrosive sublimate 1 : 5000, or in formalin solution 2 per cent. Before use soak again in the solution for thirty minutes.

As smooth rubber presents an almost non-absorbable surface, provided the cleansing is thorough, the articles are readily made sterile.

Gloves are less liable to tear and more easily adjusted if put on wet and inflated either with sterile water or antiseptic solution.

Rubber Tissue.—Sterile rubber tissue is frequently used as a dressing to cover granulating surfaces. It protects delicate granulations from being torn, which is liable to happen when dressings that have stuck to the tissues are removed.

To prepare: Scrub lightly first in cold water, then in tepid soap and water, and rinse in cold water. Place over the tissue a layer of gauze the same size and cut both together to the required shape and size.

Pack in sterile jars, a layer of gauze between each piece of tissue.

Fill the jars with bichlorid of mercury 1 : 10,000, and leave for twenty-four hours.

Pour off and refill either with fresh solution of the same or sterile normal salt solution. The latter is usually preferred, especially if the tissue is to be used for skin-grafting or extensive granulating wounds.

Rubber tissue should be tested before using, as it is liable to become brittle. In good condition it is pliable and slightly elastic. The tissue is dissolved by heat, ether, chloroform, turpentine, and similar preparations.

Rubber Catheters, Rectal Tubes, Etc.—The cleansing and sterilization of these articles, and more especially of catheters, is so important that a special formula should be insisted on in caring for them.

Immediately after use, wash under running cold water, using a funnel, as described, two minutes by the clock; leave soaking in cold water at least three minutes longer.

Scrub in tepid water and suds; rinse under running cold water.

Run boracic 2 per cent., or formalin 2 per cent. through the catheter repeatedly (at least ten times), and soak in the same thirty minutes; rinse again under running cold water. Boil ten minutes.

Stretch repeatedly between the fingers until dry, and put away dry.

Repeat the boiling for five minutes immediately before use, and wrap in a sterile towel until required, or, if preferred, place in a 2 per cent. boric acid solution.

The formula may be applied to rectal tubes, stomach-tubes, and rubber tubing used for drainage if required to be used again. Rectal tubes used for oil enemata quickly deteriorate, as it is practically impossible wholly to remove the oil from the inside. They should be kept by themselves, as other rubber articles, if put with them, are also spoiled by the oil.

In most hospitals it is a rule that *new* rubber tubing, catheters, etc., are thoroughly washed as above, and boiled for fifteen minutes as a preliminary precaution, or it may be sterilized in the autoclave under 15 pounds pressure for forty-five minutes.

Catheters of Glass or Metal.—These are sterilized by boiling, usually ten minutes after use and cleaning, and five minutes before use, are required. As they can be sterilized with certainty, glass catheters are used wherever practical in preference to rubber ones.

The finest (**filiform**) **catheters** and **bougies of hard rubber** or of **silk** may be roughened and cracked even by the above method of sterilizing, and should never be boiled. Frequently they are simply thoroughly cleaned with soap and water and laid in alcohol, 75 per cent., half an hour before use. Carbolic solution 1 : 20, or formalin 2 per cent., may be used instead of alcohol, or they may be sterilized in the autoclave.

Rubber catheters, tubing, and similar articles are so difficult to sterilize with any certainty that if used for an infected case, they should be reserved for the individual use and destroyed when finished with.

Rubber sheets or **mackintoshes** are not usually required to be sterile. After use, however, especially after an infectious or a septic case, they must be carefully disinfected.

Remove organic material with cold water; if it is not practical to clean them immediately, stained rubber sheets should be put to soak in cold water while still wet. This will dissolve the albumin and prevent stain-marks.

Scrub with soap and tepid water and rinse very thoroughly in cold water: sand-soaps scratch and spoil the rubber and must not be used.

Immerse in an antiseptic solution for a specified time—for example, corrosive sublimate 1 : 5000 or in formalin 2 per cent. for one-half hour.

Rinse, wipe, and hang in the air until dry. Avoid folding in putting away; hang over a wide wooden rail, or lay extended on an unused mattress.

GLASS, CHINA, AND ENAMELWARE

Glass and china are easily cracked in the autoclave if carelessly packed without due allowance for expansion (p. 427), if placed directly in very hot water, or if too rapidly cooled; otherwise articles of glass, china, or enamelware can equally well be sterilized in the autoclave, by boiling, or by soaking in a strong antiseptic, such as bichlorid of mercury 1: 500 or carbolic acid 1: 20 for one hour, or formalin 2 to 5 per cent. for half an hour. Glass or good china stand sterilization better than enamelware, which either with heat or chemicals quickly loses its polished surface. Exposure to heat, as in the autoclave, also seems to loosen the enamel and leave it liable to chip easily, and the rough surface so exposed is a harboring-place for dust.

SUTURES AND LIGATURES

These may be divided into two classes—non-absorbable and absorbable.

Non-absorbable Sutures.—These are used where strength and security are the requisites, as in closing wounds. Those in general use are:

Silk-worm gut.	Horsehair.
Silk.	Silver wire.
Linen.	

All the above may be sterilized by boiling ten minutes except silk, which is weakened if boiled for longer than five minutes.

Silkworm-gut (fishing-gut) is the ordinary suture or stitch used in closing wounds. It is the silk-producing gland of the silkworm, stretched into a long strand and dried while fully stretched. It forms a smooth, white, strong strand, non-absorbable and non-porous, stiff and bristly when dry, but softened by hot water. The strands vary from 12 to 18 inches long, the average length being about 14 inches. The different thicknesses cannot be accurately assorted, depending, as they do, on the size and the stretching quality of the gland. They are sold in three sizes,—fine; coarse, and medium,—with an extra fine and an extra coarse not always easy to be obtained.

The tied ends of the sutures when dry are sharp and prickly; where this may cause discomfort, they may be clamped with shot.

As silkworm-gut causes a certain amount of scarring, it is not usually used on exposed surfaces, such as the face or hands.

Silkworm-gut contains in itself no pathogenic organisms, is not altered by exposure to dry heat, nor spoiled by boiling, and is permeable to antiseptics; it is, therefore, readily sterilized.

Frequently the silkworm-gut is dyed, usually with iron dye, which gives it an antiseptic quality. The formula is as follows:

Cut off the ends and boil eight minutes.

Pour off the water.

Boil fifteen minutes in ferrous sulphate, 25 per cent.

Pour this off.

Boil five minutes in tannic acid, 10 per cent.

Stand a few hours, then pour off and dry.

After drying wash in cold water; it is then ready for use.

To prepare: Wash by scrubbing on a board with hot soap and water, and rinse thoroughly under running cold water.

Fold in a piece of gauze, a dozen strands at a time, put

up in the usual wrapper of double muslin, and sterilize in the autoclave with the other dressings for forty-five minutes under 15 pounds pressure.

Immediately before use soften by immersion in boiling water for one minute. (Longer immersion will not injure the suture.)

A second process of sterilization is as follows: Place so many strands, six or twelve together, for example, in glass-stoppered jars filled with a 1 : 500 solution of bichlorid of mercury; the solution should be hot. After twenty-four hours empty the solution and fill two-thirds full with pure alcohol, taking care to cover the strands; boil ten minutes in a water-bath. The strands are kept in the jars in which they are sterilized until they are to be used, when they are softened by immersion for not less than a minute in boiling water.

Many hospitals sterilize the silkworm-gut only by boiling ten minutes just before use; soda must not be used in the water. Repeated boiling is not considered to injure the suture.

In threading the needle pass about one inch through the eye, bend sharply, and twist together twice to prevent slipping.

Silk.—A good quality of silk, both black and white, of various sizes, is frequently used for suturing, especially in operations about the face, where it is important to avoid scarring. For different purposes plain, twisted, or braided silk is preferred, in sizes 5 to 8. Silk is also used in work on delicate tissue, such as the intestines, kidneys, and gall-bladder, and other internal organs, and for tying pedicles, etc. Its advantages are that it is strong and very pliable, and that the knot does not slip.

To prepare, for convenience, strands 27 inches long are wound on separate glass spools. Four or six spools of one size of silk are prepared and placed end to end in a wide glass tube, a wad of cotton being laid at the lower end and between each spool to avoid knocking together; the tube is also plugged with cotton. The size of the silk should be marked on the tube.

Silk may be sterilized by boiling five minutes, or the

tubes, filled and plugged, are placed in the autoclave and the silk sterilized twenty minutes.

The sterilized tubes may be kept conveniently in covered glass jars.

Linen.—Some surgeons use linen in place of silk for intestinal sutures, etc. It is stronger than silk, more easily fastened and tied, stiffer and easier to thread when wet. Also, having less capillarity, linen is considered to present more resistance than silk to infection passing along the thread.

Two varieties are used:

Black, sizes 0 and e.

Pagenstecher, sizes 0, 3, 5 (fine, medium, heavy).

Linen is sterilized by boiling ten minutes.

Horsehair.—Sutures of horsehair, taken from the horse's tail, are not much used at the present day, but are still occasionally preferred for fine stitching on the face or scalp. The sutures are removed at an early date. Horsehair forms a fine elastic suture, but breaks easily under tension. They require careful preparation, especially on account of the risk of possible contamination by the tetanus bacillus, one of the spore-producing organisms.

To prepare: Separate coarse from fine hairs, and cut in strands of equal length (16 to 20 inches); knot 12 together at either end, and scrub on a board with hot soap and water. Rinse under running water. Cut the strands an inch below each knot, and twist into a loose coil. Place the coils in sterile, glass-stoppered jars, filled with sufficient pure alcohol to cover the coil, and sterilize in the autoclave, or, if preferred, place the closed bottles in a water-bath and boil ten minutes on three successive days.

Keep in the alcohol jars until required. In threading the needle a surgeon's knot is tied below the eye to prevent it slipping.

Silver Wire.—Wire sutures of pure virgin silver are used chiefly in suturing bone, and are removed when their purpose is accomplished.

To prepare: Scrub on a board with hot soap and water, rinse, dry, wind in a loose coil, and keep in a clean, covered box in a dry place. To sterilize, boil ten minutes.

In threading, pass half an inch through the needle, bend sharply, and twist once.

Silver in itself has certain antiseptic properties, and the sutures have an antiseptic influence on the tissues with which they come in contact.

Absorbable Sutures.—Catgut, Kangaroo tendon. The value of these sutures is that, being themselves organic substances, they are absorbable by the human tissues, and can, therefore, be used for ligatures and for deep sutures which are to be retained.

Catgut.—Catgut is obtained from the small intestine of the sheep. Its preparation is not invariably left to the nursing staff; in many hospitals, and usually in private practice, it is procured, fully prepared and sterilized, in sealed tubes from surgical dealers. (See below.)

Very careful preparation and sterilization indeed are necessary, for the reason that the tissues of the sheep may contain organisms that produce disease in man, and the catgut itself, being an organic substance, can act as a medium, under suitable conditions, for the development of germs with which it comes in contact; such, for example, as the pus-producing organisms. The sheep may be infected by such organisms as the tetanus and the anthrax bacilli. Both these varieties, we remember, are subject to spore formation (p. 359); the methods of sterilization must, therefore, be sufficient to destroy spores. At the same time the process must not make the catgut brittle or weak, nor must antiseptics be used that will irritate the tissues into which the catgut is introduced.

If catgut, in its unprepared state, is exposed to boiling, a substance named *collagen*, of which catgut is largely composed, is converted into gelatin, completely spoiling the suture. Dry heat does not alter catgut if the catgut itself is perfectly dry; the least moisture, however, is sufficient to act upon the collagen and convert it into gelatin when the catgut is exposed to heat. Catgut is, in fact, an extremely difficult substance to prepare, requiring conscientious care at every step.

Properly prepared catgut is free from fat or moisture, pliable, smooth, and tough. A ligature that feels hard and wiry is usually brittle, and should be discarded. In tying,

good ends must be left to the knot, as, in contact with the warmth, moisture, and cell activity of the human tissues, catgut swells, and if allowance is not made, the knot may slip. This is the common cause of post-operative hemorrhage.

In most of the processes of preparation the catgut is wound on glass spools; care must be taken to wind in a single layer, otherwise, where the strands cross, the pressure prevents the necessary drying and hardening from taking place, and a weak spot results, which will break under strain. The coil is most conveniently cut into three lengths.

Catgut comes in various sizes, numbered from 00 to 8. In some of the preparation methods the time required for immersion in the agent varies with the different sizes. The minimum is reckoned for 00, the maximum for 8. The sizes most used are from 0 to 4.

Prepared catgut is conveniently stored in wide-mouthed glass bottles with ground-glass stoppers. These must be carefully washed and sterilized before being used. All necessary handling during the process of preparation and sterilization must be done with sterile forceps. The best media for storing catgut are alcohol, glycerin, or simple oils; these have no action on the collagen, *provided all moisture has been removed.*

The following methods are in use in many hospitals where the catgut is prepared by the nursing staff, and can be carried out without special apparatus:

Plain Catgut.—Cut the strand into three lengths and wind in a single layer on glass spools; place the spools in a sterile jar, cover with ether, and stopper closely; leave for twenty-four hours, shaking the jar at intervals. This process removes the fat and so prepares the catgut for the antiseptic. Pour off the ether and refill the jar with 1:500 solution of bichlorid of mercury in pure alcohol; replace the stopper and stand aside for one hour.

Transfer the spools to sterile, wide-mouthed bottles, and cover with pure alcohol; stopper closely and place in a water-bath; boil ten minutes on three successive days. By this process the collagen has been removed and the boiling will not injure the catgut. The boiling is repeated

each time before use. The catgut is not taken from the jar until required for use.

Other methods of preparation have for their object the making of the catgut resistant for a longer time to absorption by the tissues. According to the process used, ligatures may be produced that will remain unabsorbed from two to six weeks. This is desirable in many important operations on the internal organs. The agents used are: iodin, cumol, formalin, chromic acid, tannic acid, alum, and others.

The date of absorption cannot be measured absolutely, as the process may be modified by many conditions, such as the state of the health, the condition of the tissues, etc.

The following are the processes in common use where such preparation is carried out by the nursing staff:

Iodized Catgut.—Cut the strand in three lengths; make a loose coil of each over three fingers; thread the coils on one strand, like beads on a string.

2. Place in a glass beaker, capacity, 500 c.c.

3. Place the beaker on a sand-bath or asbestos mat in a hot-air oven (as used in laboratories).

4. During fifteen minutes raise the temperature to 100° C.; maintain at this temperature fifteen minutes further (*dry heat*).

5. Pour liquid albolene into the beaker, sufficient completely to cover the catgut, and raise the temperature gradually during fifteen minutes to 140° C.; maintain fifteen minutes and then turn off the flame (*moist heat*).

6. Leave to cool for twelve hours; relight, and bring to 140° C. in fifteen minutes; maintain at 140° C. fifteen minutes further; turn off the light.

7. Leave to cool for three hours; lift out the coils with sterile forceps, cut the connecting thread, and drop into wide-mouthed, stoppered bottles, previously sterilized, containing $\frac{1}{16}$ per cent. solution of iodin in pure alcohol.

The catgut is ready for use after forty-eight hours in the iodin solution (Philadelphia Polyclinic and others).

Formalin Catgut.—1. Wind a whole coil of catgut on any convenient cylinder (such as an empty ether can) in a single layer.

2. Soak in formalin (3 per cent.) for from one and one-

half (size 00) to five hours (size 8), according to the size of the catgut. The catgut will be brittle if left too long in the formalin.

3. Wash in running water for twice the time that the catgut has been in the solution.

4. Roll in a single layer on a wide muslin bandage, and dry in the sun and open air. Finally—

5. Wind in a small coil round three fingers and store in glass-stoppered jars.

Catgut prepared in this way may be boiled without injury, as the gelatinizing substance has been removed. The ligatures are boiled fifteen minutes before use.

A Second Process.—After the immersion in formalin and washing in running water, as in the first process, transfer directly to sterile, glass-stoppered jars; fill with sufficient pure alcohol completely to cover the catgut; place the jars in a water-bath and boil fifteen minutes on three successive days. In place of the pure alcohol some use a 10 per cent. solution of glycerin in pure alcohol.

Chromicized Catgut.—For this process a special glass spool is used, with a notch on either flange, by which the catgut is kept stretched and prevented from shrinking.

1. Cut the coil in two lengths, wind each tightly in a single layer on one of the reels, pass each end through its notch, and secure by passing one end through the barrel and tying both together.

2. Immerse the spools for from twenty-four hours to three days, according to the size of the catgut, in a chromic acid solution, as follows:

Bichromate of potash	1.5 gm.
Glycerin and pure carbolic, each	10.0 c.c.
Water	1000.0 c.c.

3. Remove and drain for a few hours.

4. Immerse the spools in 1:500 solution of bichlorid of mercury in pure alcohol for six days.

5. Transfer with sterile forceps to sterile, wide-mouthed bottles, cover with pure alcohol, and stopper closely. Chromicized catgut can also be boiled without injury. It is boiled for fifteen minutes before use.

Instead of using the bichlorid solution, the chromicized

catgut may be treated with 3 per cent. formalin, as described, using the second process, and stored in a 10 per cent. alcoholic solution of glycerin.

Cumol Catgut.—Cumol, a chemical compound with a boiling-point of 165° C., is, at the present day, much in favor as a preparation for catgut ligatures. It dissolves the fat in catgut, but unless carefully used is liable to make it brittle. To avoid this, the catgut must be very slowly dried by carefully graduated dry heat before the cumol is added; if this is done, a glue-like substance forms on the gut which will keep it supple.

Cumolized catgut is most conveniently prepared in a special sterilizer, with which full directions are given. The preparation may, however, also be carried out, using a sand-bath and a glass beaker. The beaker should have a cardboard top, through a hole in the center of which a thermometer is passed, in order to ascertain the temperature at each step, which is of the first importance. As cumol is highly inflammable, the beaker should be covered with copper-wire netting to prevent accidents. The bottom of the beaker is covered with a layer of cotton, on which the catgut, wound and stretched on the special glass spools just described, is placed.

The first process is to dry the catgut. Placing the apparatus over a gas Bunsen burner, the temperature is slowly raised to 80° C., as follows:

First hour	20° C.
Second "	40° C.
Third "	55° C.
Fourth "	70° C.
Fifth "	80° C.
Sixth "	80°–85° C.

By the end of the sixth hour the catgut should be free from moisture and ready for the cumol.

Seventh hour: Lower the light and add cumol at a temperature of 100° C. sufficient to cover the catgut. Bring the temperature to 165° C. and maintain at this temperature for one hour.

Pour off the cumol and keep in the sand-bath at a temperature of 100° C. for two hours, in order to dry the catgut.

Store either dry, in sterile tubes, or in pure alcohol in the usual stoppered bottles.

Not only the time involved, but the risk that the process should not be effectually carried out, cause most hospitals to prefer buying their catgut ready prepared from some reliable firm. The iodized catgut of Davis and Geck, New York, is one of the most popular at the present day. It is sent out in hermetically sealed jars, which have been dehydrated to prevent deterioration. Besides the catgut in each jar is enclosed a glass tube containing 45 grams of iodin crystals. The jar is made with a hollow glass chamber in the center. The jar is opened under strict aseptic precautions, the tube opened and the crystals poured into the center chamber. The jar is then filled with 6 ounces (180 c.c.) of 95 per cent. alcohol, covered securely and allowed to stand ten minutes, then gently shaken to distribute the iodin evenly, and the catgut is ready for use. It is more supple if allowed to stand for twenty-four hours. The strength of the iodin solution so formed is $\frac{1}{4}$ of 1 per cent. This is highly germicidal and at the same time non-irritating.

At the present moment iodized catgut is preferred to all other forms.

Kangaroo Tendon.—In special cases, where it is desirable to retain a suture for an unusually long period, as, for example, in suturing bone, a suture made from the split sinew of the tail of the kangaroo may be preferred in place of catgut. The methods of preparation are the same as for catgut.

DUSTING-POWDERS

Some preparations, such as iodoform, are actively germicidal only when in contact with wound secretions; others are mixed with non-antiseptic preparations, such as starch powder, etc. These may be contaminated with bacteria from dust, etc., and should, therefore, be sterilized regularly in the autoclave and kept closely covered. If perforated metal covers are used for the dusting pots, they (the covers) should be boiled daily and the pots kept in wide covered glass jars.

Iodoform is altered if subjected to a temperature of

239° F. or over. The powder is sterilized in the autoclave at 7 pounds pressure for forty-five minutes. During sterilization iodin vapor is given off; this should be allowed to escape by covering the jar only with a fold of gauze; if retained in the jar, the whole powder will become iodized and useless for its purpose. When this has happened, the iodoform is turned brown.

OILS AND OINTMENTS

These may be sterilized twenty minutes in the autoclave at 15 pounds pressure.

If to be sterilized by boiling, place the jar or flask in a water-bath of *warm* water, bring to boiling-point, and maintain half an hour. Cool slowly to avoid cracking. **Glycerin** is usually sterilized in this way. The boiling should be repeated on three successive days, as oils and ointments readily harbor germs. Jars and flasks should be only two-thirds full. Flasks are plugged with absorbent cotton; jars should have the lids lightly adjusted over a double layer of gauze. Lids should not be screwed on during sterilization or the glass jar may break.

Small bottles or jars previously sterilized may be conveniently filled for use in the wards from the sterile supply.

SOLUTIONS

Provided the vessels are sterile and that the solutions are made from filtered sterile water, no further sterilization is necessary for the ordinary dressing solution.

Any solution, however, that is to be introduced directly into the circulation (as normal salt solution), or used to irrigate a closed cavity (as the peritoneum), must be sterilized in the autoclave twenty minutes under 15 pounds pressure or by boiling by the fractional method.

DRESSINGS

Loose-meshed, bleached gauze is now universally used for surgical dressings and for sponges. Hospitals, as a rule, have their own special shapes and sizes for these dressings. The cut edges should be turned in to avoid ravelings, which might adhere to raw surfaces. This is especially necessary in making gauze sponges.

For sterilization a known quantity of cut gauze is wrapped in a double cover of unbleached muslin and sterilized in the autoclave for forty-five minutes at 15 pounds pressure. Not more than is necessary for one complete dressing should be done up in one wrapper. Dressings, such as perineal pads, eye-pads, etc., may be done up six or twelve in one wrapper, the wrapper so folded that only one pad is unfolded at a time. Sponges are put up in packets of 6 to 12 as required. The contents of all packages should be marked on the wrapper in blue pencil. In many hospitals gauze dressings and sponges which are to be used inside the abdominal cavity are sterilized by the fractional method. After the first sterilization they are left twelve hours, then again sterilized at 15 pounds pressure for thirty minutes. Besides the dressings cut to cover wounds, gauze is used to establish drainage and to pack cavities. Gauze bandages, $1\frac{1}{2}$ inches wide, are used for this purpose, to avoid the raw edges of the cut gauze. These are cut into lengths of one yard and packed into sterile glass tubes, which are stoppered with absorbent cotton. They are sterilized with the other dressings in the autoclave.

Towels, sheets, caps, gowns, etc., are wrapped, like the dressings, in covers of double muslin and sterilized twenty minutes in the autoclave at 15 pounds pressure.

All sterile articles should be kept in their covers until actually required for use. It is the only certain way of keeping them from possible contamination by dust or handling. Portions of dressings not used must be collected and resterilized.

Medicated Gauze.—For special purposes dressings and packings of medicated gauze are used—gauze, that is to say, impregnated with some agent, usually either antiseptic or stimulant. During the *antiseptic* period of surgery gauze impregnated with carbolic acid, with bichlorid of mercury, and other antiseptic preparations were much in favor; at the present moment iodoform gauze is the only one of such dressings much in use. It is chiefly used in the packing and dressing of tubercular sinuses.

Iodoform Gauze.—Iodoform gauze may be sterilized in the autoclave at low pressure (7 pounds for forty-five

minutes), when prepared, but there is always the risk, if the temperature is accidentally raised, of the whole dressing being spoiled by the action of the iodin vapor given off by the iodoform at 239° F., as described above. The composition of the dressing is altered, and the dressing useless for its purpose.

To avoid this risk, each of the articles to be used may be previously sterilized separately and the whole process carried out with strict aseptic precautions. All the vessels are sterile, and the nurse scrubs up her hands as if for an operation, and wears gown and gloves.

Gauze is cut to the necessary sizes and shape, and sterilized in the usual way.

Make an emulsion as follows, the ingredients previously sterilized:

Iodoform powder and glycerin, equal parts, to which some add bichlorid of mercury, 5 grains to every half pint of the mixture.

Rub together in a mortar; when perfectly smooth, add to the whole mixture half the quantity of pure alcohol; mix by shaking thoroughly in a good-sized bottle.

Place the gauze in the mortar, pour on the emulsion, and work with the hands until thoroughly impregnated.

Fold, roll lightly, and store in closely stoppered jars of *dark* glass. If dark glass is not available, the jars should be kept in a dark closet, away from direct sunlight, which will iodize the iodoform, or the jars may be covered with asbestos paper.

Different prescriptions are used in various hospitals for the emulsion, thus:

(*a*) Iodoform .... 1 ounce.
Salt solution (9:1000) .... 5 ounces.
Castile soap, sufficient to make thick suds.

(*b*) Iodoform .... 1 pound.
Glycerin .... 1 pint.
Boiling water .... 2 pints.
Castile soap, sufficient to make thick suds.

Plain gauze after use can be washed, sterilized, and used again, thus diminishing the expense of dressings.

In one hospital that makes a practice of washing the gauze the following procedure has been found practical:

The used gauze is collected, at the dressings or operations, in stout mesh bags, such as are used in machine laundries for the washing of small articles; the bags must not be more than half full. The bags are kept until collected in covered garbage-cans. They are collected twice a day, placed directly in one of the laundry tubs, and washed in the following order:

Cold rinse........................	5 minutes.
Hot suds........................	10 "
Hot rinse........................	5 "
Cold rinse........................	5 "
Boiled........................	5 "

The bags are then drained and hung in the drying closet until partially dry; while still damp the gauze is pulled into shape, trimmed, and packed for sterilization like other dressings. The only drawback to the process is the labor involved in pulling the gauze into shape again. The washed gauze is softer and more free from fluff than the unwashed gauze.

SEA-SPONGES

Sea-sponges are not entirely out-of-date. On account of their absorbent property, they are frequently preferred in operations complicated by copious mucoid secretions, as, for example, on the mouth and tongue, or, more rarely, the cervix.

In preparing, care must be taken to remove thoroughly the sand and lime deposits found in sea-sponges.

1. Beat with a wooden mallet to break up and remove shells, sand, and dirt; wash at intervals in cold running water, soaking in cold water between the times. Repeat until free of dirt.

2. Soak in 1 : 64 solution of hydrochloric acid to dissolve lime deposits.

3. Soak in a saturated solution of permanganate of potash fifteen minutes.

4. Soak in a saturated solution of oxalic acid until bleached—usually about half an hour.

5. Wash in two waters.

6. Soak for twenty-four hours in bichlorid of mercury 1 : 1000.

7. Transfer to sterile jars, fill the jars with carbolic 1 : 20, and cover closely. Keep in this solution until required.

Before use the sponges are wrung out in normal salt solution and washed in the same during use.

As they will not keep in this way more than about two weeks, only a small number should be kept ready for an emergency. If used for a clean case, they may be washed and resterilized. After an infectious case they should be discarded.

HAND-BRUSHES AND NAIL-CLEANERS

After use, wash under running cold water and soak in formalin (2 per cent.) for thirty minutes; wash in hot suds and dry quickly, to prevent softening of the bristles.

Put up in convenient packages and sterilize with the dressings in the autoclave. During an operation they are usually kept in an antiseptic solution. A fresh set should be put out for each operation.

CULTURES

Sterilized articles should be examined from time to time to insure that the process is adequate. To do so, a *culture* is taken of the material to be examined. A small fragment of the sterile object is removed, with strict aseptic precautions, and dropped carefully into a tube of sterile culture bouillon. The tube is plugged with cotton (which should be ignited for a moment before being replaced), and kept in a dark place at a temperature of about 98° F. for twenty-four hours. If the specimen is sterile, the bouillon remains clear. If it becomes cloudy, the microorganisms should be developed and examined in the usual way (p. 372). Cultures should also be taken from time to time from the finger-nails of those engaged at an operation

CHAPTER XIV

SURGICAL TECHNIC AND MINOR SURGICAL EVENTS

Principles Governing Technic—Duties of Sterile and Unsterile Nurses—Technic in Preparation of the Skin—Surgical Dressings—Carrel-Dakin Method—Hypodermoclysis—Intravenous Infusion—Venesection—Injection of Antitoxin Serums—Exploration—Lumbar Puncture—Venous Puncture for Blood Culture—Paracentesis—Aspiration of Chest Wall; of Pericardium.

PRINCIPLES OF TECHNIC

Having carefully prepared and sterilized everything that is to come in contact, direct or indirect, with the open wound, we have now to consider how to keep all "*sterile*" during an operation, a surgical dressing, or other surgical procedure.

At the present day the methods used have become a species of drill, in which each has a definite part to play. From early days it is to be recommended that probationers should be taught their drill until it is performed with mechanical precision. The demonstration can be carried out in the class-room with dummy dressings. Some nurses will at once grasp the principles involved, but they will work better and more quickly for having their duties well defined; others will require to be drilled again and again until perfect, but under present-day methods it is far too important a point to be left to pick up in any haphazard way.

While everything that comes in contact, directly or indirectly, with the wound must be surgically clean, there are many things necessarily involved at an operation, etc., that are, so to speak, surgically "*dirty*." For example, the patient's body, with the exception of the field of operation; the gown and coverings of the patient; the table and stands; the outside wrappings of sterile dressings; spiggots and door-handles; besides bottles, stoppers,

exhaust pumps, and any appliance that it may be impractical or unnecessary to sterilize.

Sterile and Unsterile Nurses. To overcome this disadvantage in carrying out surgical technic, as we call it, these unsterile objects must be handled by persons who do not come in contact with the open wound. In technical language, the assistants at an operation, etc., are divided into "*clean*" or "*sterile,*" and "*dirty*" or "*unsterile.*"

A "clean" nurse is one whose hands are "scrubbed up" according to formula, in addition to which, except for very minor proceedings, her ordinary dress is covered with a sterilized gown; gloves must also always be worn where the hands have to come in contact with the raw surface or with discharges, and are desirable in most surgical proceedings.

A clean nurse is no longer "clean" if she touches any unsterilized object; in technical language, she has "broken her technic"; an unsterile nurse, if she touches any sterile object, whether with her hands or skirts, has opened a channel of possible infection and broken the technic possibly of an entire operation. An unsterile object laid down among sterile objects must, in strict technic, be regarded as having rendered the whole unsterile. Thus if a dirty instrument is placed in a tray of clean ones, the whole must be resterilized. Water and lotions are no longer *sterile* if touched with the unsterilized hand, as, for example, to test the temperature, or if an unsterile sponge or instrument is thrown into the basin; dirty instruments, etc., must not be added to objects in process of sterilization; if this happens accidentally, *the whole* must be resterilized with the article just added.

Constantly a nurse meets with the direction "with strict aseptic precautions"; the measures these words are intended to imply should present themselves to her mind, down to the most minute detail, without hesitancy or confusion. While there are always several ways of attaining results, perfection in nursing is best arrived at by teaching one way thoroughly and leaving little for individual initiation.

A practical plan in teaching technic to a young class of probationers is to smear the fingers of "clean" and

"unsterile" nurses respectively with rouge and with charcoal: a touch in the wrong place is then quickly detected.

Strict technic is not possible unless two work together. In certain conditions, as on night duty or in private nursing, this may be impossible; it is then important that the nurse should understand exactly the point at which she must prepare her hands and beyond which she must keep "clean."

The duties of *clean* and *unsterile* nurse may be briefly detailed as follows:

The Clean Nurse (**Nurse No. 1**).—As she is responsible for the dressing (or etc.), she first collects and arranges conveniently all that is to be used, and places articles to be boiled in the sterilizer. At this point she summons the unsterile assistant and prepares her own hands according to formula, and after this she is "clean," and must touch nothing but the sterilized objects and the actual area of operation. She must not, for example, help to move the patient, touch the bed-clothes, or the outside of lotion bowls or bottles, etc., open a door, or turn on a spiggot; neither must she touch her own face or any part of her dress not protected by a sterile gown. If a sterile gown is worn, it is put on after her hands are prepared; the gloves are drawn on last of all.

In beginning her dressing, etc., her first act is to provide herself with a sterile area to protect her hands and sterile appliances from contact with unsterile objects. For this purpose sterilized towels are used, one to cover a table on which she can place the necessary instruments and dressings, and others to cover the area, etc., in the immediate neighborhood of the dressing, disposing them above, below, and on either side of the part to be dressed. She must remember once the towels have been placed on an unsterile object, only the upper surface remains sterile. She finishes her preparation by taking from the open packets handed her by her unsterile helper the necessary dressings and appliances.

Her remaining duties vary with the requirements of the individual process. She remains *clean* until the open surface, puncture, etc., is covered by the dressing. Before

applying the outer bandage after a dressing, she removes her gloves, or, if these are not worn, rinses her hands thoroughly in antiseptic lotion, otherwise the bandage itself may be infected with any organism present in the wound secretions, and become a channel of infection.

For the same reason, before leaving the bedside, after any except surgically clean proceedings (such as hypodermoclysis), the hands should be immersed as a matter of routine for one full minute in the antiseptic solution preferred, and must be washed and disinfected again, according to formula, before any other object is touched.

In minor surgical proceedings, if by accident technic is broken, the hands must be immersed a full minute in antiseptic solution before resuming; should a sponge or instrument that is to come in actual contact with the tissues touch an unsterile object, it must, in strict technic, be discarded, or the whole process of sterilization repeated; for this reason, and to provide against accidents, it is best, in preparing for catheterization, hypodermoclysis, exploration, etc., to prepare two catheters or two needles, rather than risk delay if a second is required.

Should the clean nurse be obliged to handle an unsterile object, for example, a flask or the air-pump of an aspirator, the object must be covered temporarily with a sterile towel or piece of gauze. If she touches a dressing not strictly sterile, she uses sterile forceps and discards them after use.

The danger of indirect infection is often overlooked. For example, a nurse may have dressed an infected wound with strict aseptic technic, and, before disinfecting her own hands, afterward, may touch a spiggot, a door-handle, or perhaps the patient's bed-clothes; on the spot she touches some of the organisms will, in all probability, be deposited. A second person may touch the same spot, her fingers will become infected, and she may quite innocently convey the infection in this way to a third. The risk is very much lessened if forceps are used instead of fingers, and gloves are worn.

The Unsterile Nurse (No. 2).—The duties of the unsterile nurse should be as clearly defined as those of the sterile nurse. The unsterile objects which it is her part

to handle include, besides the patient and the bed-clothes, the wrappers containing the sterilized objects, mackintoshs or Kelly pad, bottles, flasks, the outside of lotion bowls, douche-cans, or pitchers, bandages, splints, and other appliances, and the receiver for the soiled dressings. These she should place together conveniently for her to handle, and out of the way of the sterile table.

While the clean nurse is scrubbing her hands, nurse No. 2 arranges the patient in proper position, pours out lotions, adjusts mackintoshes or Kelly pad, if required, and unpins the sterilized packages, holding them open for No. 1 to take from them what she wants.

If the skin is to be prepared, the preliminary scrubbing and shaving is the part of the unsterile nurse; she follows it with an alcohol wash (p.449), and if there is any delay, covers the part with a towel wrung out of bichlorid of mercury 1 : 1000; the sterile nurse begins the disinfection by repeating the alcohol wash, or, if another formula is used, with the application of the antiseptics. For the preliminary scrubbing mackintoshes are used to cover the clothing—one, or two, as required; they may then be removed or covered with sterile towels, as indicated by circumstances. They should, for example, be retained for douching, irrigation, or if there is likelihood of bleeding.

The clean nurse prepared, nurse No. 2 fastens the gown behind, since No. 1 can hardly do this without touching her ordinary dress. She then unpins and opens the packages and hands them to No. 1, beginning with the towels for the sterile area; finally she brings the boiled articles from the sterilizer. These may be carried in the tray on which they were sterilized, or removed to a sterile towel with a pair of sterile forceps. Throughout the process she follows what No. 1 is doing carefully, anticipating her wants, and guarding herself carefully from touching any sterile object, even with a view to helping.

Frequently a limb may have to be held, movements restrained, or such an object as a tourniquet controlled, in the immediate neighborhood of the sterile area. Nurse No. 2 must then place her hands *underneath the sterile*

coverings, taking care not to touch the upper surface of the towels or to get in the way of the *clean* operator.

If the unsterile nurse has to touch a sterile object, as, for example, in transferring an instrument from the sterilizer, or taking a towel or sponge from the sterile packet, she uses a pair of sterile forceps. An old pair of forceps should be kept standing in antiseptic lotion beside the sterilizer.

In all aseptic proceedings a basin of antiseptic lotion, usually bichlorid of mercury, 1 : 1000, *hot*, should be placed in readiness in case the technic is accidentally broken. With two nurses working together this should not happen. The replenishing of the lotion bowls is the duty of No. 2. It is not necessary or practical to keep the outside of lotion bowls sterile; in handling the bowls care must be taken not to hold them by the brim, since the inside must be kept sterile.

Volatile drugs, such as alcohol, ether, etc., are used when required directly from the flasks. The necessary quantity is poured by the unsterile nurse onto a sterile sponge held by the clean nurse.

In pouring solutions, etc., from bottles, the brims of the bottles should be wiped free of any possible dust with a sponge soaked in a little of the solution; the stopper should be held in the little finger of the left hand, to prevent it coming in contact with other objects.

In giving an aseptic douche, irrigation, or hypodermoclysis, the rubber tubing is best divided into two parts connected by a piece of glass tubing; the lower length alone is handled by the sterile nurse, and kept strictly sterile throughout. Although the whole apparatus is sterile to start with, the douche-can, flask, etc., and the upper length of tubing are most conveniently handled by the unsterile nurse.

The principal aseptic measures in which nurses are constantly engaged are: the preparation of the field of operation; minor dressings; catheterization; hypodermoclysis; to which may be added, assisting at minor surgical procedures in the ward.

It is an immense help that the technic required for each of these proceedings should be written down. The direc-

tions should include a list of the articles required, any special method for sterilizing the articles, the formula required for preparing the hands, the area of the skin to be prepared, and, for convenience, the position in which the patient must be placed.

The technic should be reduced to the simplest compatible with good standards; elaborate technic is too often an excuse for carrying it out imperfectly. Where only one nurse is available for aseptic measures, as may happen in private nursing or on night duty, it is important that the nurse should understand exactly the point at which she must "scrub up," and beyond which she must keep "*clean.*"

For the proceedings that are constantly called for, the preparation of the skin, catheterization, and hypodermoclysis, etc., trays may be kept ready with all the articles necessary.

Cleansing the Hands.—The technic required for the cleansing of the hands should be typed and posted in a conspicuous place, preferably over the wash-stands, since the importance of this part of all technic cannot be overestimated. The hands of nurses and dressers are considered, without doubt, the most common channels of infection in hospital work, and the weak link in the chain of aseptic methods.

Two formulas for preparing the hands are in use in the wards: The first, *Formula A*, should be the same as that required for the purpose in reparing for operations; this is used in the preparation for minor operations, for important dressings, and other circumstances especially indicated. A second formula (*B*), a modification of the first, is used in preparing for minor dressings, catheterization, vaginal douching, and similar proceedings. The directions for special technic should state which formula is to be used.

Formula A.—Whichever preparation is in use in the hospital operating room (p. 448).

Formula B.—Turn the sleeves up above the elbows and scrub the hands and well above the wrists *three minutes* in hot soap and water, using hand-brush; change water once; clean round nails with blunt orange-stick. Immerse in *hot* solution of bichlorid of mercury (or

Harrington's solution, etc.) for *two minutes;* rub the solution briskly into the skin.

The mechanical scrubbing is the most important part of either formula.

N. B.: To lessen the risk of establishing a channel of infection, the hands must be immersed and rubbed in the antiseptic solution for one full minute before leaving the patient's side wherever a raw surface has been exposed, if the hands have come in contact with organic secretions, and after changing the linen or removing the bed-pan, etc., from an infectious case, after which they must immediately be again cleansed according to formula.

The custom of using gloves for all aseptic proceedings is a great safeguard against infection; in the wards the mended rubber gloves may be used, or cheap cotton gloves, which can be washed and boiled.

PREPARATION OF THE SKIN

The formula used in preparing the skin for minor surgical events varies in different hospitals. For the most important the same formula in use in the operating-room is required (Formula A). For simple punctures (hypodermoclysis, etc.) the skin is thoroughly washed in soap and water, sponged with an antiseptic solution, and covered till ready with a piece of gauze wrung out of the solution. Alcohol may be preferred to the antiseptic solution (Formula B). This is the duty of the unsterile nurse.

DRESSINGS

In present-day methods a general dressing-room, fitted for any emergency, is a common part of hospital equipment; the patients are taken from the wards to have their dressings changed, and most minor surgical measures are likewise carried out with more privacy than can be looked for in a ward.

In a large school it is not always easy to give each nurse her full time in this department, and there is further the disadvantage that, where all is kept prepared for every sort of contingency, the pupil nurse loses sight of what is essential for each different event, and is at a loss when on her alone falls the responsibility of preparing one or the other. Thus the very perfection of equipment may be a stumbling-block in the training unless steps are taken to counteract this drawback by individual teaching.

For an ordinary dressing the following articles should be prepared:

Towels (4 a good average).
Sponges (12).
Gauze dressing.
Absorbent cotton pads.
} In sterile packages.

Dressing scissors, probe, and forceps (boiled ten minutes), bandage, and safety-pins.

Bowl of sterile water or antiseptic solution (in case the dressing should stick or the wound require washing).

Bowl of antiseptic solution for the hands.

Receptacle for soiled dressings.

Fig. 155.—A surgical dressing.

Where there are cavities requiring to be treated with injections of special preparations, such as iodoform emulsion, peroxid of hydrogen, etc., a glass syringe and small measure-glass or gallipot are further required, and may be boiled with the instruments. A tube of gauze packing should also be prepared.

If **irrigation** is necessary, the douche-can and tubing are prepared and wrapped until required in a sterile towel, together with a convenient flat bowl, usually of the kind known as *kidney shaped;* this latter is boiled with the

instruments and kept sterile throughout. A Kelly pad or a piece of rubber sheeting should be put in readiness for all irrigations.

In preparing for a dressing after an operation, a pair of scissors with sharp points and an extra pair of forceps should invariably be ready, in case a stitch should require to be removed unexpectedly.

Where an incision is to be made, the following should be prepared, in addition to those mentioned above. All, of course, are sterilized:

Knife.

Sharp scissors.

2 artery forceps.

Surgical needle.

Catgut ligature.

Suture, either of silk or silkworm-gut.

If an abscess cavity is to be opened, there should also be added curet, drainage-tubing, and tube of gauze packing.

In many instances the knife only may be used, but in preparing the above, all emergencies are provided for, such, for example, as severing a blood-vessel, or the necessity for closing part or all of an incision.

It will also probably be necessary to have ready the local anesthetic. For clean incisions, punctures, and similar proceedings, anesthetics, such as novocain, cocain, eucain, etc., are generally administered by hypodermic along the line of incision, and a hypodermic charged with the necessary amount should be in readiness; where an abscess is opened, freezing is the usual form of local anesthesia (p. 329).

For a dressing the hands are prepared by Formula B, if gloves are worn; if not, Formula A must be used; a gown also should be worn. Where several dressings follow each other, the hands are cleaned by Formula B between each dressing, and always immersed in the antiseptic solution a full minute before leaving the bedside. The instruments used must also be cleaned and resterilized between dressings. Two sets are necessary, in order to avoid delay.

The minor dressings intrusted to nurses are usually of the chronic variety of wounds with discharging surfaces.

The surface is cleaned with sterile water, or, more usually, with antiseptic solution. In cleansing a wound, the surrounding area must first be cleaned, washing always *away* from the wound, and the raw surface last. Sponges are wrung out as dry as possible, and each sponge is discarded after using once. In the first treatment of a wound due to an accident, where the surrounding tissue is dirty, the actual wound should be covered with a sponge soaked in an antiseptic, while the area round is thoroughly cleaned, usually with soap and water. In removing a dressing or packing that has become dry, force must not be used; not only will pulling cause needless pain, but delicate granulations will be destroyed and troublesome bleeding may be started. The dressing should be moistened until it comes away easily.

In packing a cavity or sinus, no rule can be laid down; in some cases just sufficient is required to establish drainage and keep the surfaces apart; in others pressure is applied by packing a cavity firmly. The tube of packing is held, and the cotton plug removed by the unsterile nurse; the clean nurse draws out the length she requires with sterile forceps, and cuts it with sterile scissors, taking care not to come in contact with the outside of the tube; holding the strip with the forceps in her left hand, she introduces the packing little by little into the cavity with the probe. The strip must not come in contact with the surrounding tissue or even with the sterile towels, since during the dressing these may very easily become contaminated with any organism present in the wound. She should also, in removing packing, hold the soiled gauze so that it does not fall on the area round the wound, which, if technic is strictly followed, should remain sterile.

Nurses must be taught to use forceps and not the fingers in removing and applying dressings and in cleansing wounds. A nurse's training should make her fastidious to the last degree in keeping her hands from possible contact with infectious organisms.

In applying a dressing, just sufficient for the purpose and no more should be used. If oozing is expected, the gauze dressing is reinforced with pads of absorbent cotton;

the bandage should be applied firmly, but not tightly, and be sufficient to keep the dressing in place; safety-pins are used to fasten the bandage, except for bandages about the head, where an ordinary long pin is preferred.

Where there is much local inflammation and in conditions where it is desirable to encourage discharge, the gauze is applied wet; sterile water, normal salt solution, or an antiseptic lotion may be used. The wet dressing is covered with a light cotton pad and bandage, or it may simply be held in place with a bandage and kept wet, either by constant dripping or by repeated application of the lotion used, without removing the bandage.

In most cases the gauze, either wet or dry, is placed directly on the wound or denuded surface. Where, however, the granulating surface is large, as in burns, for example, it is covered first with a *protective*, usually rubber tissue, in order to prevent injury to the delicate granulations if the gauze should stick and be removed with force. The tissue should either be perforated freely, or it may be laid on in strips, leaving a small space between the strips, otherwise the dressing will act as a poultice and encourage oversecretion.

Collodion Dressing.—Punctures are usually closed with a collodion dressing. For this are required:

Small bottle of flexible collodion.
Fragment of sterile cotton.
Sterile applicator or brush.

In applying the dressing, the puncture is wiped free of blood, and a thin strand of cotton, merely a few threads, laid over the small wound. Over this an application of collodion is painted, and then a second layer of teased-out cotton again covered with collodion; the cotton layer and the collodion application are repeated until the wound is covered sufficiently. The dressing falls off in a day or two, but, if necessary, it can be dissolved with a little ether.

The practice, not unknown, of keeping a brush in the collodion bottle and applying it to all and sundry is not only dirty, but contrary to all modern principles of technic.

The dressing after an operation is not, as a rule, left to

the nurse. Her duties will be to prepare all that is required and to act as unsterile assistant. Unless oozing occurs, the dressings are usually left undisturbed until the incision is healed. Oozing is, however, common in many conditions, whether of blood from small, unligated vessels, serum, or solutions where cavities have been freely irrigated. Some surgeons, for example, after special abdominal operations, irrigate the peritoneum with salt solution, leaving a certain amount in the cavity to be absorbed gradually. When oozing occurs, it is usual to remove the top dressings and apply a fresh one with the same aseptic precautions as for a full dressing. The nurse is expected to watch such dressings and report promptly if oozing is taking place, as once it reaches the outer dressing a channel of infection is opened between the wound and the outside air.

Removal of Stitches.—Stitches after an extensive operation are commonly removed about the ninth day, though symptoms of tension or local irritation, or the necessity for establishing drainage, may require their removal at an earlier date. Stitches about the face are removed after a much shorter interval, in order to avoid scarring.

After stitches are removed, an incision is frequently supported by strips of adhesive strapping. A small dressing of dry gauze is generally kept over an incision until the scar tissue is quite strong.

THE CARREL METHOD

Carrel Method for the Treatment of Infected Wounds.—This method, usually known in America as the Carrel-Dakin method (from the antiseptic solution commonly used, see below), is considered the most important contribution to surgical technic evolved in the recent war. It was introduced by a French surgeon, Dr. Carrel, in his treatment of war wounds, and is at the present date in common use in all kinds of septic surgery. By this method every part of the wound is irrigated at regular intervals by an antiseptic solution without disturbing the dressings.

The Carrel method has two procedures:

1. The local treatment.

2. The observation of the progress of disinfection by means of smears taken at regular intervals and examined in the laboratory.

Local Treatment.—A special apparatus is necessary, comprising:

Fig. 155*a*.—Various sizes of instillation tubes. Tubes 5, 10, 15, and 20 cm. in perforated length; also simple and loop tubes. (From Technic of the Carrel Method, by I. Dumas and Anne Carrel, translated by Adrian V. S. Lambert.)

1. Flask.
2. Conducting tube.
3. Distributor.
4. Instillation tube or tubes.

Instillation or distributing tubes (Fig. 155*a*) are made of fine catheter rubber, size 16 French (4 mm. interior diameter), from 0.3 to 0.5 m. long, open at both ends, the lower

end usually tied with linen thread, which is easily removed when cleaning the tubes.

A *simple* tube has one large lateral opening close to the end and is not tied; *perforated* tubes have openings $\frac{1}{2}$ to 1 mm. in diameter, 1 cm. apart to a distance 5, 10, 15 or 20 cm. from the tied end; in a *loop-shaped* tube the

Fig. 155*b*.—Distribution of instillation tubes covered with Turkish toweling and provided with guy threads for fixation at edge of wound. (From Technic of the Carrel Method, by I. Dumas and Anne Carrel, translated by Adrian V. S. Lambert.)

central portion is perforated. Where the treatment is for extensive flat surfaces the tubes used are usually covered with Turkish toweling the length of the perforations (Fig. 155*b*). This aids considerably in the distribution of the fluid. The toweling is firmly sewn round the tubes. A pair of linen threads are passed through the

toweling long enough to extend beyond the wound, where they are fastened to the skin by strips of adhesive plaster, thus keeping the tubes in position.

The instillation tubes are attached to a glass *distributor,*

A B

Fig. 155*c*.—Conducting and instillation tubes: A, Conducting tube, *CT*, shown connected with distribution or instillation tubes, *IT*, by a glass distributor, *C*, with four outlets. B, Loop instillation tube connected up with a glass distributor. (From Technic of the Carrel Method, by I. Dumas and Anne Carrel, translated by Adrian V. S. Lambert.)

of which there are several shapes (Fig. 155*c*); the comb shape is perhaps the most frequently used.

The distributor is connected at the upper end with the *conducting* tube, a length of rubber tubing 7 mm. in diameter, attached to the flask containing the antiseptic fluid

and provided with a stop-cock, by which the flow is regulated. Where desirable, a double set of instillation tubes may be fed from one flask by dividing the conducting tube with a **Y**-shaped glass connecting tube (Fig. 155*d*),

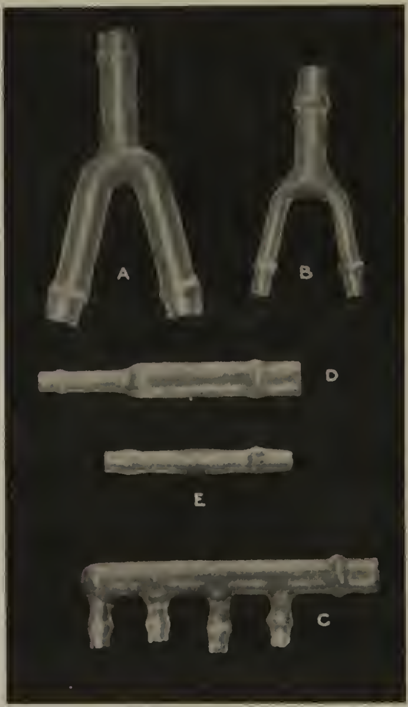


Fig. 155*d*.—Glass conducting connector and glass distributors. Glass connector, *A*, is 7 mm. diameter throughout; glass distributors (*B*, *C*, *D*) have a diameter of 7 mm. at the larger end and 4 mm. at the smaller. *E* is a small connecting tube of 4 mm. diameter. (From Technic of the Carrel Method, by I. Dumas and Anne Carrel, translated by Adrian V. S. Lambert.)

to each arm of which a secondary conducting tube is attached.

The flask, usually of glass, holds 1 liter; the neck is stoppered with sterile cotton, the lower part ends in a short open tube, over which fits the rubber conducting tube. The flask is suspended from 2 to $2\frac{1}{2}$ feet above

the wound to be treated, usually from a wooden post attached to the foot of the bed and provided with a hook at the required height. If preferred an adjustable supporting stand such as depicted in Fig. 155*e* may easily be contrived.

The antiseptic at present used is Dakin's solution of

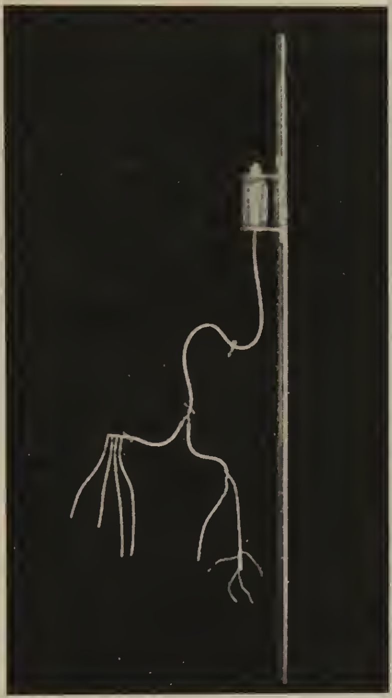


Fig. 155*e*.—Irrigation apparatus, showing supporting stand with flask in place. Attached are main conducting tube, glass conductor, secondary conducting tubes, glass distributors, and instillation tubes. (From Technic of the Carrel Method, by I. Dumas and Anne Carrel, translated by Adrian V. S. Lambert.)

sodium hypochlorite, strength between 0.45 and 0.5 per cent.; a weaker solution is ineffective, a stronger is irritating to the tissues. The solution is decomposed by heat and is used cold; light also changes its composition and reserve supplies should be kept in dark bottles.

Dakin's solution is free from any trace of caustic soda, and must for this reason be distinguished from other commercial hypochlorite solutions, such as Labarraque's solution and Javel water.

The apparatus in position, the instillation tubes are placed over the surface and into the cavities of the wound or wounds. The dressing used is usually gauze wrung out of Dakin's solution and laid over the tubes; cavities and flaps are lightly packed with the same, the dressing aiding in the distribution of the fluid. Bandages or binders when necessary must be lightly applied so as not to constrict the tubes. In prolonged treatments it is usually advisable to smear the adjacent skin with sterile vaselin. Where necessary the bedding is protected by rubber sheeting on which are laid pads of gauze and cotton which can be changed with little disturbance. The customary technic for dressing is used.

The dressing in place, every two hours day and night the cock is opened from one to three seconds, allowing the fluid to seep into every part of the wound.

All parts of the apparatus are cleaned by washing in soap and water; the flask is rinsed with Dakin's solution and the glass parts and conducting tube soaked in the solution for two hours before use. The instillation tubes are put up in large glass test-tubes stoppered with cotton and sterilized in the autoclave at 120° C. for twenty minutes, and remain in the test-tubes till ready to be used.

Microscopical Examination.—The progress of disinfection is followed by means of smears taken from the infected area (page 364) at regular intervals, sometimes every second day, or at longer intervals at first, and more frequently as disinfection progresses. These are examined in the laboratory, and according to the report the surgeon decides when the wound is ready to be closed.

When a smear shows "only *isolated* cocci or diplococci, and only one is found in every four or five fields (microscopic), and if this result has been verified by two or three successive examinations at intervals of one or two

days, the disinfection is practically accomplished. The surgeon may then close the wound with a fair assumption of success, no matter whether it is a wound of the soft parts or a compound fracture."[1]

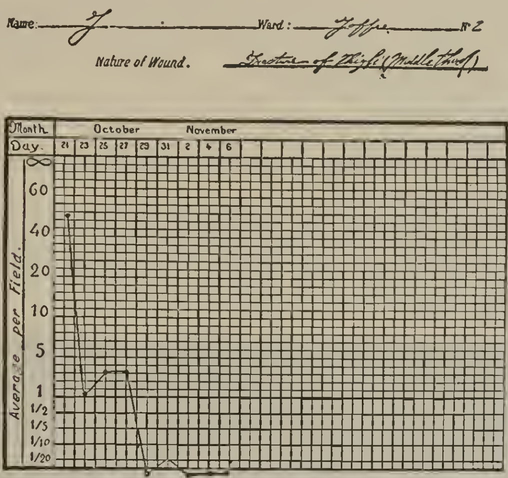


Fig. 155*f*.—Graphic record of bacterial count. (From Technic of the Carrel Method, by I. Dumas and Anne Carrel, translated by Adrian V. S. Lambert.)

It is usual to keep a chart of the bacterial count, which may easily be adopted from the usual temperature chart (Fig. 155*f*).

HYPODERMOCLYSIS OR SUBCUTANEOUS INFUSION

Infusion of either hot normal salt solution or of sterile tap water into the subcutaneous tissue is a method of treatment which, at the present day, a nurse is constantly required to carry out. At present some doctors prefer tap water to normal salt solution on account of the thirst caused by the latter.

The technic, though simple, requires attention to various details, which, if not clearly grasped, may cause confusion and make it difficult not to break technic.

[1] Technic of the Carrel method by I. Dumas and Anne Carrel.

The hypodermoclysis tray should contain:

The special flask or douche-can with length of rubber tubing.

Separate short length of rubber tubing, with glass connection tube, to be kept sterile throughout.

Two hollow, sharp-pointed needles, about three inches long.

6 gauze sponges.

2 towels.

} All sterilized and in sterile wrappers.

2 flasks of a capacity of 500 c.c., containing sterile water or normal salt solution.

Collodion dressing (as described), to which are added a bowl of lotion for the hands, and a stand from which to hang the flask. The flask is elevated about 3 feet above the bed.

Fig. 156.—Giving hypodermoclysis.

The solution may be siphoned directly from the flask in which it has been prepared, using a glass drinking tube and a length of rubber tubing, to which the hypodermo-

clysis needle is attached. Usually in hospital work a special apparatus is reserved for hypodermoclysis. Kelly's infusion flask (Fig. 156) is a graduated glass flask with a narrow neck and opening at the lower end, like that of a douche-can, to which the tubing with the needle is attached; the flask is graded to 700 c.c., the numbers beginning at the top, so that the amount given may be read at a glance.

The hands are prepared by Formula A or Formula B, if gloves are worn. Gown and gloves are not considered essential, but some hospitals insist on them for all aseptic measures.

On the side of the "clean" nurse is placed a table partly covered with a sterile towel, on which she arranges the gauze sponges, the needles, and the sterile length of tubing; the basin of hand lotion is placed on the uncovered part of the table.

On the opposite side the unsterile nurse keeps irrigation apparatus, stand, and the flasks of water or normal salt solution, one hot and one cold; also the sterile packets mentioned until the clean nurse is ready to have them opened. The bandage is cut from the brim of the flask, but the cotton stopper is kept in place. The contents of the flask are heated over a gas ring or in a water-bath.

While nurse No. 1 is preparing her hands, nurse No. 2 washes the skin area with soap and water and covers it with a piece of gauze wrung out in bichlorid solution; her next act is to take the apparatus from its wrapper, hang it on the stand, clamp the tube, and fill the flask to the top graduation with the solution of the required temperature. The outside of the flask and tubing can no longer be considered sterile, and are not touched by nurse No. 1.

The "clean" nurse begins by arranging her sterile area. She next attaches the needle to the sterile length of tubing, and, taking the glass connection tube in a piece of sterile gauze, joins the two lengths of tubing. The clamp is now loosened.

Technic.—Before inserting the needle, the clean nurse allows the water to run freely over the back of her hand. This is both in order to expel all air and to gage the temperature. The temperature should be from 114° to 120° F. The usual test is that the fingers should just be able to rest on the glass flask. The temperature may also be tested

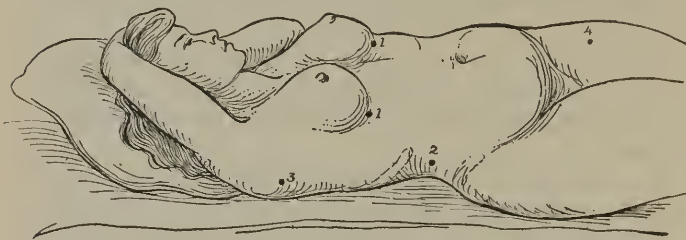


Fig. 157.—Sites for hypodermoclysis: 1, Under the mammary glands; 2, in the subcutaneous tissue between the crest of the ilium and the last rib; 3, in the subcutaneous tissue in the axillary space; 4, in the subcutaneous tissue on the inner surface of the thighs (Morrow).

by keeping a long dairy thermometer in the flask during the process (Fig. 156). This must, of course, also be sterile, and should be kept until actually required in an antiseptic solution, bichlorid of mercury 1 : 1000, or formalin 2 per cent. From time to time it may be necessary to add hot water or hot solution in order to keep up the temperature,

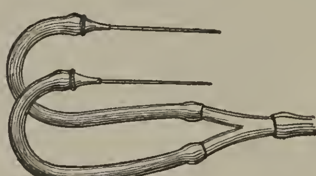


Fig. 158.—Showing two needles arranged for hypodermoclysis (Morrow).

if the process is a long one and the fluid runs very slowly. The quantity added must be noted accurately, so that it can be known how much the patient is having.

In a woman the site usually chosen is the base of the breast; other favorable sites are the loose skin just below the axilla, the muscles of the chest wall or the abdomen,

the thigh, and under the shoulder-blade. The needle is introduced horizontally about two-thirds of its length, and withdrawn about an inch; while inserting the needle, the skin is held stretched by the left hand.

As a rule, not more than 500 c.c. should be introduced at one site. The fluid should flow slowly: about twenty minutes is required to introduce 500 c.c. with one needle. If desirable, the injection may be given at two points simultaneously, as in both breasts. In this case a T-shaped glass connection-tube is attached to the upper length of rubber tubing, to each arm of which a separate length of rubber tubing, with needle attached, is connected.

The infusion started, in ordinary circumstances the second nurse may be dispensed with unless she is required to add hot solution. The clean nurse may do this if she is careful to handle the flask with a sterile towel or piece of sterile gauze.

Care must be taken to withdraw the needle while there is still some solution remaining in the flask. The tube is clamped before the needle is withdrawn, in order to avoid spilling the contents.

A nurse may frequently have to give hypodermoclysis single handed. She must then arrange all required, heat the solution, and fill the flask before "scrubbing up"; she then prepares the site, as this involves touching unsterile objects; after this part is complete she rinses her hands in the bichlorid solution, puts on gloves, before introducing the needle.

By this process fluid is introduced into the lymphatic circulation, and conveyed in due course by the lymphatic vessels to the blood-current; some of the solution is also directly absorbed by the capillary blood-vessels. The tissues immediately around the puncture become infiltrated with the fluid, causing a circumscribed swelling, which is gradually absorbed without intervention. A cotton pad and bandage will hasten the absorption, but this is not generally considered necessary.

In the treatment of diabetic coma a solution of glucose (solid grape sugar) is frequently given, either by hypoder-

moclysis or intravenous infusion. (See below.) The strength used is 5 per cent. glucose dissolved in boiling sterile distilled water (50 grams in 1000 c.c.). The solution is filtered into flasks and sterilized by boiling in the flasks for five minutes.

INTRAVENOUS INFUSION

Where a more immediate stimulation to the circulation is required, the fluid may be injected directly into the blood-current by opening a vein in the forearm.

In addition to the articles required for hypodermoclysis, the following must be prepared:

Scalpel.

Aneurysm needle and silk ligature (heavy).

2 artery forceps and catgut ligature (for emergency).

Surgical needle and suture, usually silk (medium size, for closing the incision).

Scissors, probe, and dressing forceps.

Intravenous needle.

Sterile, flat-bottomed basin.

Gauze dressing, extra sponges, towels, and gauze bandage.

Tourniquet or muslin bandage.

The intravenous needle is a fine cannula, 3 or 4 inches long, resembling a hypodermoclysis needle, but slightly curved and with a blunt point.

The operation is, of course, performed by a doctor, but a *clean* assistant is necessary to act as a free pair of hands. The hands are prepared by Formula A; gown and gloves are worn.

The surface of the forearm to a point well above the bend of the elbow is prepared by Formula A.

The instruments are arranged on the sterile table, with the gauze sponges, sterile length of tubing, and sterile basin; the tourniquet, bandage, and unopened dressings, with the infusion apparatus, on the unsterile side. The preliminary part of the skin preparation is, as usual, carried out by the unsterile nurse. A piece of rubber sheeting is kept under the arm during the whole process; in arranging the sterile area, one towel is placed below the

arm, covering the rubber sheeting; one covers the upper arm, and one envelops the forearm. The sterile basin is placed under the arm, below the point of incision.

Before the incision is made, a tourniquet or a tight bandage is applied around the upper arm, in order to distend the veins of the forearm. The tourniquet should be sufficiently tight to distend the veins, but not so tight as to obliterate the pulse at the wrist. The control of the tourniquet is the duty of the unsterile nurse; in order to be free, she must previously have prepared everything necessary; packets must be opened, instruments brought from the sterilizer, the apparatus ready for use. When the needle is in place, the tourniquet is gradually loosened and finally removed. The nurse is careful to keep her hands *underneath* the sterile covering.

The sterile assistant will be required to keep the arm extended and still, and, if the patient is restless, this will take her entire attention; with a quiet patient she can spare a hand, if desired, to help with any sterile object. Before taking her place, she must attach the needle and connect the two pieces of tubing as described, and also see that the fluid is running freely.

Technic.—The operation is as follows: the vein is exposed by a light incision; the silk ligature is passed, by the aneurysm needle, under the vein, below the point to be opened, and tied; the vein is then opened, and the cannula inserted, making sure first that it is free of air, and running the solution over the back of the hand to test the temperature.

As the vein fills, the tourniquet is slowly loosened and finally removed, leaving the unsterile nurse free to watch that the temperature of the fluid is kept up, and help, if necessary, to control the patient.

About 500 c.c. are injected. The cannula is then withdrawn, the incision closed, usually with a stitch, and a gauze dressing applied. The bandage should be applied sufficiently firmly to keep the elbow extended, and the patient should be cautioned to keep the arm still for the first day.

Great care must be taken to stop the injection while

some fluid is still in the flask, otherwise air might be forced into the vein. Air in any quantity forced suddenly into a vein causes dilatation of the left chambers of the heart and of the pulmonary vessels, a condition always fatal, and usually causing death in a few minutes. Such an accident could take place only through gross carelessness in such a process as intravenous infusion, as, for example, by allowing the flask to become perfectly empty and refilling it with the needle in place. Still, nurses should be cautioned that such a risk exists.

VENESECTION; PHLEBOTOMY

Intravenous infusion is also carried out with the object of diluting the toxins in the blood in such a condition, for example, as uremia. A certain quantity of blood is then first allowed to flow from the vein before the needle is introduced. A flat, graduated vessel should be sterilized and placed below the arm at the point of incision, so that the amount withdrawn can be estimated at a glance. The operation is, otherwise, precisely similar to that just described.

The pulse is taken and recorded before and after either hypodermoclysis or intravenous infusion, and a note made of the same, with the hour, the amount injected, and, in the latter case, the quantity of blood withdrawn from the circulation.

BLOOD CULTURE

In certain infectious diseases and acute septic conditions bacteria are found in the blood, and for diagnostic purposes it may be desirable to make a culture directly from the blood of the patient. For this purpose a small quantity of blood is withdrawn from a vein. Several test-tubes containing the culture-media preferred must be in readiness, as it is important the blood should be immediately placed in the culture-media before it has time to clot or become in any way altered.

This is also a puncture operation, apparently a very simple process, but in which want of care in strict attention to detail would have disastrous results. Strict

asepsis is necessary to avoid infection, since the needle directly enters a large blood-vessel, and further care must be taken that no air is allowed to enter the vein. The risk of the latter is not great, and is avoided altogether if the vein is well distended, as the pressure so effected causes the blood to flow into the needle as soon as it is introduced into the vein.

The articles required are:

Small exploring needle with tube attachment.
Test-tube.
Culture tray.
Preparation tray and hand lotion.
Gauze pad.
Bandage.
Tourniquet.

The needle and test-tube should be as carefully sterilized as for lumbar puncture. A special needle attached to a small glass tube is frequently used in place of the ordinary exploring needle.

The forearm is prepared by Formula A and the veins distended by the application of a tourniquet or tight bandage to the upper arm. As in intravenous infusion, it must not be so tight as to obliterate the pulse at the wrist. In venous puncture the tourniquet is retained until the process is over.

The hands are prepared by Formula A: gloves and gown are worn; the unsterile nurse, besides her usual duties, will be required to apply the tourniquet and to hold the arm extended (under the sterile covering) during the operation.

When the vein is sufficiently distended, the needle is plunged into the vein without a preliminary incision; the blood is caught in the sterile test-tube, and transferred immediately to the culture-media. About two drams is generally taken. The wound is covered with the gauze pad and a firm bandage; sufficient pressure should be applied to control any tendency to bleeding, and the arm be kept extended and at rest for some time. Discoloration or tenderness round the puncture must be reported at once. Antiseptic compresses, either hot or iced, are usually applied if such a condition arises.

TRANSFUSION

By transfusion is meant the transfusion of the blood of a healthy individual directly into the vein of the person in need of such treatment. The transfusion tube most in use consists of a glass tube with a capacity (for adults) of 10 ounces. The lower end terminates in a fine pipet, the upper is closed with a rubber cork. A short glass arm near

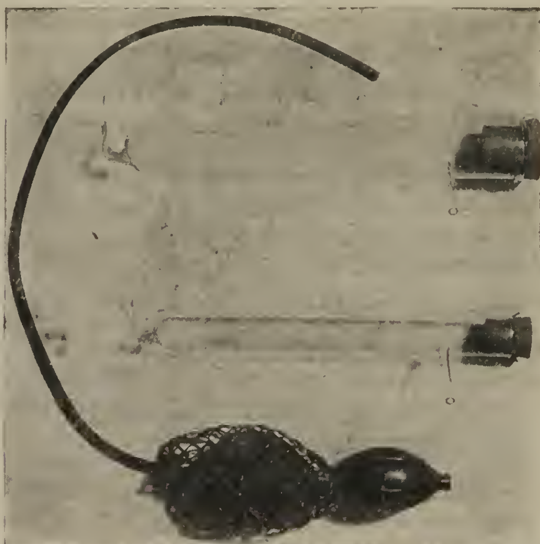


Fig. 158*a*.—Kempton-Brown transfusion tubes; two sizes, 100 c.c. and 250 c.c. cautery bulb (Mason, in "Surgery, Gynecology, and Obstetrics").

the upper end is for the attachment of a simple ball hand-pump. The inside of the tube is prepared with a coating of paraffin renewed each time the tube is used, which prevents the blood from coagulating.

To line the tube proceed as follows, using strict aseptic precautions:

Prepare a sterile table, with a packet of sponges, a packet of towels, and rubber gloves.

On a second table have an alcohol lamp and a pan of paraffin.

Sterilize the tubes for thirty minutes under 15 pounds pressure; on removal from the autoclave place upright on the sterile table for a few moments till all moisture is dried off.

The hands scrubbed up and the gloves put on, take the tube, adjust the cork, and move the tube to and fro over the alcohol flame till evenly heated.

Attach a piece of tubing to the short upper spout and suck the melted paraffin up into the tube through the spout to about one-quarter the capacity of the tube; remove the tubing.

Take the tube in both hands with a gauze sponge held tightly over spout and pipet; revolve it till the paraffin has coated the entire inside; pour back a little through the spout and pipet and round the cork to about one-third of its depth; stand upright to cool and harden. A sponge soaked in alcohol rubbed over the tube will hasten this part of the process. If the lining is not evenly done it must be repeated.

Wrap each tube in a sterile towel with two pieces of rubber tubing.

After use, blood is cleaned from the inside with cold water followed by ammonia or peroxid; the paraffin is removed with a piece of gauze soaked in benzin. When thoroughly clean the tube is wrapped with a cork and two or three pieces of rubber tubing ready for sterilizing.

The Operation.—In this operation two are concerned, the *donor* (the healthy person from whom the blood is to be obtained) and the patient.

The Donor.—The procedure is the same as that described above for intravenous infusion. When the vein is opened the pipet is introduced directly into the vein, when the blood will flow into the tube. If the blood does not flow easily it may be helped by using the hand-pump. As this is not sterile, it is worked by a non-sterile assistant, and connected by a piece of glass tubing to a short length of sterile rubber tubing fitted on to the short glass spout at the upper end of the tube. Sixteen to 20 ounces is usu-

ally taken. The operation over, the wound is closed as described above.

The Patient.—The procedure is again the same as described above for intravenous infusion.

As soon as the tube is filled with the blood of the *donor* it is taken to the *patient* and the pipet introduced directly

Fig. 158*b*.—Transfusion. Donor's vein exposed, ligated centrally, and tube ready to be introduced into vein, the tip directed peripherally (Mason, in "Surgery, Gynecology, and Obstetrics").

into the vein of the patient. The wound is closed as described above.

The above method is known as *indirect transfusion,* and has practically replaced *direct transfusion* where the vein of the donor was temporarily united to the vein of the patient. Transfusion is used in conditions of grave anemia from disease, or following severe hemorrhage.

INJECTION OF ANTITOXIN SERUMS

The injection of antitoxin serum (p. 401) is not essentially different from other hypodermic injections. The syringe commonly used is like a large hypodermic syringe, with a needle three or four inches long. For more convenient handling the needle is connected with the syringe by a short piece of rubber tubing. As always, special care is necessary to see that all air is expelled, and the needle filled with the serum before it is inserted.

The articles required for the injection are as follows:

Syringe and needle.
Phial of antitoxin serum.
Packet of towels (2).
Packet of gauze sponges (4).
Preparation tray.
Collodion dressing.
Bowl of antiseptic lotion for the hands.

The hands are prepared by Formula A; gloves and gown are worn.

Fig. 159.—Mulford antitoxin phial.

The sites usually chosen are the sides of the abdominal wall or the loose tissue under the shoulder-blade; the site is prepared according to formula.

The strictest care must be taken to keep the serum from contamination during the process. The phial is not opened until the hands are prepared and the gown and gloves put on; the syringe is filled directly from the phial

after every part has been carefully sterilized. Serum, being highly albuminous, the syringe and needle must be carefully cleaned in *cold* water immediately after use, to dissolve the albumin. The syringe used should be kept strictly for this purpose.

To insure absolute sterilization, the diphtheria antitoxin sent out by the Mulford laboratories is put up in sealed phials, shaped like a small glass syringe, with sterile needle and small length of tubing. A mark across the nozzle of the phial indicates the point at which it is to be broken and the needle connected with the phial by the piece of tubing. The drugs administered by "piqûre" on the continent of Europe are put up in the same way. Flasks of normal salt solution, 500 c.c., are also, on a larger scale, prepared on the same principle, and are exceedingly convenient for private practice.

MINOR SURGICAL PROCEDURES

The following surgical measures are frequently performed by the surgeon in the wards or the patient's room, the nurse usually acting as unsterile assistant. If required to help as "clean" assistant, she scrubs her hands by Formula A, and puts on gowns and gloves, keeping herself as carefully "sterile" as though for a major operation.

As unsterile nurse, she will be required to prepare all that is necessary, keeping sterile and unsterile articles separate, to place the patient in the proper position, to prepare the skin area, and to remain at hand to handle unsterile objects, to fetch anything accidentally omitted, or to support the patient. If the operation is carried out in a private room, she must provide the necessaries for the surgeon to prepare his hands according to formula, and have gown and gloves in readiness.

The possibility of shock after minor operations, performed without a general anesthetic, especially those that are lengthy and fatiguing, must be borne in mind. An extra blanket and hot-water bag should be in readiness, and a stimulant prepared, such as whisky or brandy, or

a hypodermic syringe charged with a dose of strychnin or of atropin.

If local anesthesia by hypodermic injection is ordered, it should be given from five to ten minutes before the operation.

EXPLORATION

It is often important, for diagnostic purposes, to explore one or other of the cavities of the body, either to determine

Fig. 160.—Method of performing exploratory puncture of the pericardium, in order to determine the nature of a pericardial exudate (Eisendrath).

the presence of abnormal fluid, or to obtain a specimen of a fluid for microscopic examination.

A large hypodermic syringe, similar to that used for antitoxin injection, is used; the needle, about four inches long, is attached to the syringe, usually, for convenient handling, by a piece of rubber tubing. It is of the first importance that these should be absolutely sterile and the needle sharp and smooth.

The other articles required are:

Sterile test-tube plugged with cotton (or culture tray).

Collodion dressing.

Bowl of hand lotion.

The patient in the required position and the area carefully prepared, the needle is passed into the cavity and the fluid drawn up into the syringe. The puncture is closed with collodion dressing: The fluid obtained is transferred to the test-tube for examination, or a culture may be taken (Chap. XI).

LUMBAR PUNCTURE

Puncture of the spinal canal, with the object of removing a portion of the spinal fluid, is employed for diagnostic purposes, or with the object of relieving pressure in such disorders as meningitis, hydrocephalus, etc. More re-

Fig. 161.—Lateral position for spinal puncture (Morrow).

cently, the process has been used for the injection of certain remedies, especially tetanus antitoxin.

In recent days anesthesia has been produced by injection of the special anesthetic into the spinal fluid. The method is still in an experimental stage.

The process is similar to other explorations, and the same articles are required: usually an exploration needle, about four inches long, with a short length of rubber tubing attached, is used without the syringe, or a fine trocar and cannula may be preferred. Some surgeons make a small preliminary incision in the skin before inserting the needle. In this case a scalpel will be required. *Two* sterile test-tubes should be prepared, and marked 1 and 2; in some

conditions it is important to distinguish between the fluid which flows as the puncture is made and that which comes after. As these tubes are most conveniently handled by a sterile assistant or the operator, they should be sterile outside also. The needle, or trocar and cannula, with the tubing, are best sterilized in the autoclave and kept

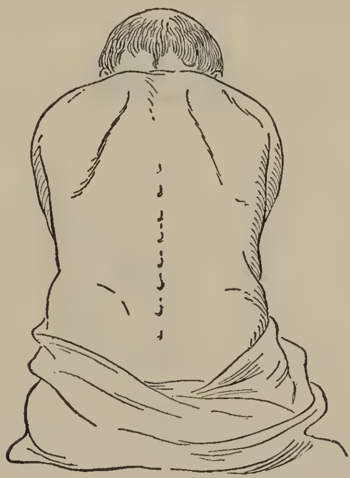


Fig. 162.—Sitting posture for spinal puncture (Morrow).

wrapped until actually to be used; if not, they should either be boiled *five* minutes and laid in alcohol at least half an hour before use, or simply boiled for full *ten* minutes. The hands are prepared by Formula A; gloves and gown are worn.

In order to introduce the needle between the vertebræ, the spinal column must be fully extended. For an exploratory puncture the patient lies on his side, the spine rounded, the head and shoulders bent forward. In conditions where the patient's health permits the patient usually sits upright, the arms crossed in front, and the head and shoulders bent forward. It will probably be necessary to support the patient in the required position, taking care to keep him absolutely still during the whole process.

The puncture is most frequently made at a point just below the fourth lumbar vertebra, which may be taken as the center of the area to be prepared; Formula A is used.

The needle introduced, the fluid is caught in the sterile test-tubes, one or two as required, which are immediately plugged with sterile cotton. The puncture is closed with

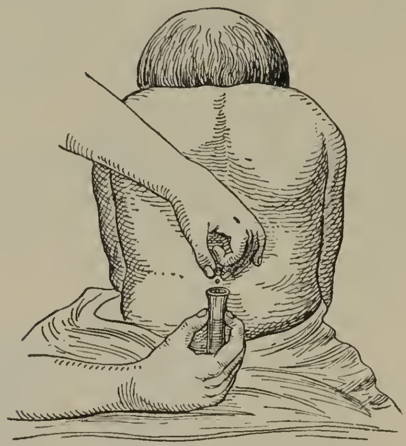


Fig. 163.—Spinal puncture: collecting the cerebrospinal fluid (Morrow).

a collodion dressing. The quantity of fluid removed, with the hour of the operation, should be carefully noted on the chart.

Simple though the process seems, it must not be overlooked that a channel of communication is opened into the most highly organized system in the body, and that infection will certainly be followed by the gravest results. There is no process in which strict aseptic technic is more absolutely necessary in every detail.

PARACENTESIS, OR TAPPING

Paracentesis, or tapping, is the method used to remove fluids from a cavity or a tumor in conditions where free opening is not suitable. The cavities of the pleura or

the pericardium may be evacuated in this way, but most frequently paracentesis is performed for the removal of fluid from the peritoneal cavity, in the condition of *ascites*, or dropsy of the abdomen.

The following articles are required for paracentesis of the abdomen:

<table>
<tr><td>Trocar and cannula, with long piece of fine tubing.</td><td rowspan="8">Sterile.</td></tr>
<tr><td>Scalpel.</td></tr>
<tr><td>Needle and suture, either silk or silk-worm-gut.</td></tr>
<tr><td>Abdominal binder, with opening in the center.</td></tr>
<tr><td>Towels, 4.</td></tr>
<tr><td>Gauze sponges, 6.</td></tr>
<tr><td>Dressing of large gauze and cotton pads.</td></tr>
</table>

Second abdominal binder.
Small empty basin (sterile).
Slop-jar or bucket.
Preparation tray and basin of hand lotion.

As the operation is long and the position fatiguing, it is always wise to have a stimulant in readiness.

The most suitable cannula is one with a short arm near the further end, to which the tubing can be adjusted while the trocar is in place. Otherwise some spilling is inevitable when the trocar is withdrawn before the rubber can be connected to the cannula. Trocar, cannula, and tubing are best sterilized in the autoclave.

The hands are prepared by Formula A; gown and gloves are worn.

Immediately before the operation the urine should be voided, as the bladder, when distended, rises above the pubes and might be injured.

The patient is supported in the upright position during the process, to insure better drainage. Some doctors prefer him to sit in an arm-chair or on the edge of the bed, the feet comfortably supported on a stool. In either case he must be made thoroughly comfortable, with pillows and warm coverings, and carefully watched for symptoms of fatigue or faintness. Where sitting up is not possible,

the patient lies on his side, the abdomen close to the edge of the bed.

A rubber sheet is arranged to protect the clothing from getting wet. With a little care there should be no spilling. The tubing is directed into the slop-jar, placed conveniently on the floor to catch the fluid.

The whole abdomen is prepared by Formula A, and, except in the case of children, generally shaved. The preparation over, the patient is placed in position, and the wide sterile binder is applied, the opening over the center of the abdomen, and fastened tightly behind. The antiseptics are again applied to the exposed surface of the abdomen, which bulges forward through the opening in the binder; two sterile towels are adjusted over the binder, one above and one below the point of incision. A minute incision is made in the skin, the trocar and cannula introduced, and the trocar withdrawn. From time to time, as the abdomen empties, the binder is tightened from behind. When sufficient fluid has escaped, the cannula is withdrawn and the incision closed, usually with a suture. A generous dressing of gauze and cotton pads is applied under a binder or a scultetus bandage. These will require to be changed later, as some leaking is bound to continue.

The necessity for keeping the area sterile during the entire process must not be lost sight of; some care will be required to keep the patient dry; wet towels must be replaced by dry ones.

A similar operation is sometimes used to remove fluid from the lower extremities in advanced cases of dropsy. Small perforated silver cannulæ, known as Southey's tubes, with fine rubber tubing attached, are introduced at different points, and the fluid allowed to run slowly away into a convenient receptacle. Similar aseptic precautions are used.

ASPIRATION

Aspiration is a method of tapping which precludes all risk of introducing air into the cavity. For this reason it is preferred to paracentesis, as described, for the re-

moval of fluid fron the cavities of the pleura or the pericardium.

Usually, as a preliminary step, the presence of fluid is first ascertained, and its nature determined by a previous *exploration*, as already described. For aspiration a special apparatus, known as an aspirator, is used (Fig. 167). This consists of a large glass bottle with a rubber cork, into which fits closely a two-armed metal tap; each

Fig. 164.—Aspiration of the peritoneal cavity. First step: application of the abdominal binder (Morrow).

arm of the tap is provided with a stop-cock; to each arm is connected a length of solid rubber tubing (the ordinary rubber tubing collapses when air is withdrawn). The rubber tubes are furnished with metal connection attachments at either end. One length of tubing is connected to an air-pump, the other to an exploring needle or a trocar and cannula. By the air-pump the air in the bottle is exhausted, thus producing a vacuum; when the exploring

needle is introduced into the cavity, the fluid naturally escapes into the vacuum.

The aspirator should always be tested immediately before being prepared for use. While each part must be carefully cleaned and sterilized after use, only the exploring needle and its connecting tube should be resterilized before use, as the sterilizing process is very apt to destroy the absolute adjustment of the different parts on which

Fig. 165.—Aspiration of the peritoneal cavity. Second step: nicking the skin at the point of puncture (Morrow).

the proper working of the apparatus depends. This tube should be in two parts, connected by a piece of glass tubing; the length to which the needle is attached is to be kept sterile throughout, and should be of a convenient length, so that the aspirator can stand on a table securely out of the way of the *clean* operator.

The needle and upper part of the tubing are usually sterilized in the autoclave, and kept until required in the sterile wrapper. The inside of the bottle is kept sterile,

in case the fluid is required for examination. The bottle, the stop-cocks, and air-pump are managed by an unsterile assistant, or, if this is impracticable, are handled with sterile gauze. The air-pump can be removed when the vacuum is formed.

To test an aspirator, fill a bowl with sterile water, adjust the parts, and open the stop-cock connecting with the air-pump; keep the other closed; work the pump until

Fig. 166.—Aspiration of the peritoneal cavity. Third step: showing the method of inserting the trocar (Morrow).

stiff, which is a sign that the air is exhausted. Close the stop-cock; place the needle in the basin of water, and open the stop-cock connecting it with the bottle; the water should run into the bottle.

If the apparatus does not work easily, the cause must be sought. Part of the apparatus may be blocked by coagulated albumin from imperfect cleansing; usually the fault is in some leakage of air caused by drying and

shrinking of the rubber cork, which may be overcome by soaking the cork in water.

After use, the greatest care should be taken to wash every part of the apparatus, with the exception of the air-pump, *immediately* under running cold water until all organic deposit is dissolved and removed.

Besides the aspiration apparatus, the usual necessaries for preparing the area, towels, gauze, sponges, hand lotion, and a collodion dressing will be required.

Some surgeons prefer to make a small preliminary incision with a scalpel before introducing the needle. This is no bigger than a puncture, and does not require suturing.

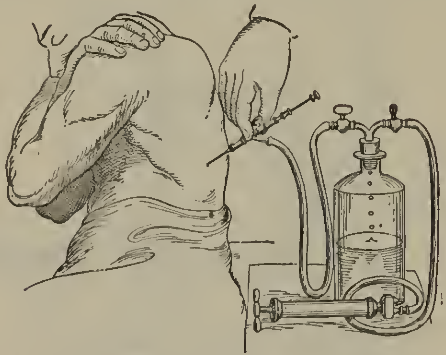


Fig. 167.—Aspiration of the pleura (Morrow).

Unless, however, a nurse is perfectly familiar with the methods of the surgeon, when a scalpel is ordered, she should prepare against emergencies, needle, silk suture, artery forceps, and catgut ligature, since, with our modern methods, these cannot be got ready in a minute.

In watching the surgeon introducing an aspirating or exploring needle, you may frequently notice he will pull the skin a little upward with his finger before beginning the insertion. By doing this the incision in the skin and the incision directly into the viscera are, when the needle is withdrawn, not exactly opposite each other.

A simple puncture is closed with a collodion dressing;

if the incision is made with a scalpel, a small gauze pad is applied, with cross-strips of adhesive plaster.

For aspiration, the hands are prepared by Formula A; gown and gloves are worn.

Aspiration of the Chest-wall (*i. e., the Pleural Cavity*).—A collection of fluid in the pleural cavity is a frequent accompaniment of disease or injury to the lungs. If the fluid is found on exploration to be purulent, the chest-wall is generally opened and the abscess drained. As a means of temporary relief, and in conditions where non-purulent fluid is largely in excess, the cavity is more conveniently emptied by aspiration.

For this process the patient lies on his sound side, in a semi-recumbent position, the arm of the affected side raised above his head, and the shoulders turned forward. Pillows arranged under the side of the chest help to bulge the ribs over the affected area.

The chest is prepared from the spine to a point beyond the axilla, and from the shoulder to the waist. The needle is usually introduced either near the angle of the shoulder-blade, or below and in a line with the axilla.

A stimulant should always be in readiness for this operation; a dose of whisky is frequently ordered as a preliminary precaution, especially if a local anesthetic is not used.

Coughing during the operation usually signifies that the visceral layer of the pleura has been pricked. The needle is withdrawn, or the lung may be injured. The sputum should be watched subsequently for traces of blood.

Attacks of syncope, sometimes even fatal, are not uncommon after the removal of a large quantity of fluid from the pleura, due, it is considered, to change in the position of the thoracic organs caused by the emptying of the sac. Patients should be cautioned to lie still and to make no sudden movement or attempt to sit up for twenty-four hours after the operation. The pulse should be carefully watched.

Aspiration of the Pericardium.—The operation does not differ in any essential from that of aspiration of the pleura. In cardiac disorders the patient is frequently compelled to keep the upright position, and in all circumstances the

position in which he can breathe most easily must be preferred. The needle is introduced at a point near the left margin of the sternum, generally between the fourth and fifth rib. This point may be taken as the center of the area to be prepared. If the chest is very hairy, shaving is necessary, but usually the process is shortened as much as possible in order to make no demands on the patient's strength. A stimulant, preferably whisky, should be prepared, but in this case is generally given after, rather than before, the operation. Local anesthesia is not usually ordered.

The condition of the patient makes aspiration of the pericardium always an important process. He must be closely watched throughout and subsequently for signs of syncope, such as changes in the pulse-rate, pallor, yawning and sighing, or coughing. Many doctors order the hypodermoclysis apparatus in readiness before beginning the operation. Where the exploring needle has shown the fluid to be purulent, the more usual operation is the opening of the pericardium, in order to drain the abscess.

Nurses cannot be too carefully impressed with the necessity for strict aseptic precautions, both in preparing for any of the above surgical proceedings and during the operation. Small though the puncture of an exploring needle or cannula may be, it is sufficient to form a channel of infection to these important organs.

CHAPTER XV

THE OPERATING-ROOM

Equipment—Duties—Operations in Private Work.

A PUPIL that has been carefully taught practical asepsis, and has intelligently grasped the principles on which surgical technic is based, will find no insurmountable difficulties in learning her duties in the operating-room. Still, the operating-room is a region in which emergencies constantly arise, in which action must follow judgment promptly, and in which a clear head, self-control, and alertness are essential qualifications if confusion is to be avoided.

No pains should be spared to make each nurse perfectly familiar with each instrument or appliance used, with the purpose of all articles in the equipment, and to teach her the proper way to hold a limb, apply and control a tourniquet, or to perform any one of the services she may suddenly be called upon to give. An emergency is obviously not the time for instruction.

EQUIPMENT OF THE OPERATING-ROOM

The tendency of modern surgery is toward simplicity of equipment, and the rule in a modern operating-room is to have nothing but what is strictly necessary for the work in hand.

The **furniture** preferred at the present day is made of white enamel, iron, and glass, which presents a non-absorbent surface and is easily cleaned and disinfected. All vessels used, bowls, trays, etc., are also either of glass or of enamelware.

The movable equipment consists of the operating-table, a convenient number of glass tables, and a couple of chairs or stools, usually in enameled iron. Of these latter, one is required for the anesthetist, and one for certain operations, such as on the perineum, at which, as a rule, the

operator sits. The tables are provided with large rubber castors or with slides, in order that they can readily be

Fig. 168.—Major operating-room (Macfarlane).

moved without lifting. A "clean" person, for example, can move such a table into position with the foot and so avoid breaking technic.

The **operating-table** in general use is also made of white enameled iron and glass, and so constructed that it can be shortened or extended and the angle changed while the patient is in place. The nurses should be familiar with

the simple mechanism by which the changes are made. The glass is arranged on the iron framework in panels sloping toward the center of the table, and with openings between the panels; by this arrangement fluids run off the table into a trough underneath, and so keep the surface comparatively dry.

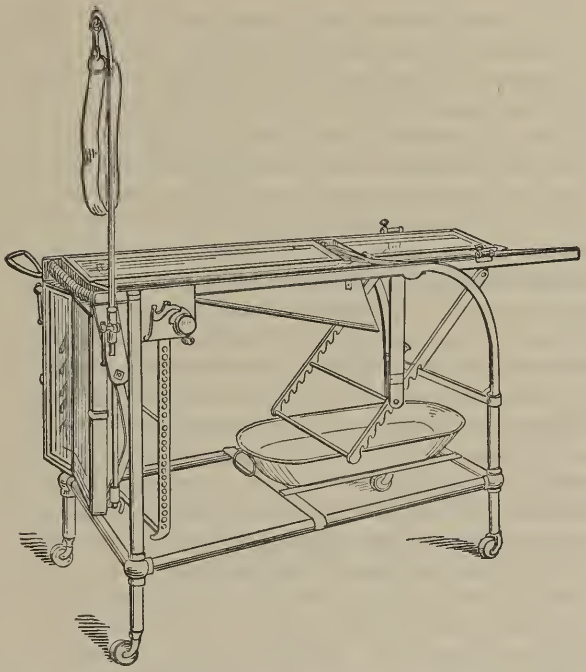


Fig. 169.—Boldt's hospital examining and operating-table, showing an adjustable stirrup with strap and a heel stirrup (Ashton).

A special bracket table of similar make may be attached to the table for operations on an extremity.

The angle of the table is altered by means of a cog-wheel, turned by a detachable handle. By this means the Trendelenburg position can be assumed (Fig. 51), and the height adjusted without disarranging the operation. In doing this while an operation is in progress care must

be taken to work under the sterile coverings, or the technic will be broken.

About one-third from the lower end the lower panels can be folded down, in order to shorten the table. At this point are a pair of metal holders, one on each side, into which the " crutches " are fitted when required, and held in place by a screw.

The *crutches* are a pair of long metal rods from which are suspended " stirrups," usually made of broad webbing (Fig. 169). Their object is to keep the lower extremities raised and separated, as in the lithotomy position. The feet rest in the webbing stirrups. When in place, the " crutches " should be at such a height that, with the feet in the stirrup, the knees are well flexed and separated.

The crutches are used for operations on the perineum, rectum, vagina, and adjacent parts.

Near the head of the table are a pair of shoulder supports, for use if the patient is put in the Trendelenburg position. These should not be used unnecessarily, as the prolonged pressure involved is quite apt to cause edema of the arm, numbness, and even temporary paralysis.

Pillows or pads of some sort are necessary to keep the patient from resting entirely on the hard table. These should be adjusted with care, as bruising of the coccyx from long pressure on the glass of the operating table is, not uncommonly, the starting-point of a bed-sore.

If pads are preferred, they should be two in number, placed lengthwise on the middle division of the table, and should not meet in the center or they will prevent the fluids draining from the table. They should be flat, stuffed with hair, and covered with rubber sheeting; they should not be larger than the panels they are to cover, or they will be in the way if the table is to be shortened.

Some hospitals use a folded blanket as a pad. The blanket is covered first with a rubber sheet, and above the rubber a cotton sheet, both tucked smoothly under the blanket. This makes an excellent pad for private work, but has the disadvantage of preventing the fluids from draining away, and in many operations keeps the back lying in a puddle.

A common practice is to use small hair pillows, covered in rubber sheeting, adjusted so as to keep bony prominences off the table. The usual requirement is one for the head, one under the shoulders, and one under the coccyx. Pads or pillows should be covered with cotton slips when in use, as rubber in contact with the skin makes it hot and moist, and favors the formation of bed-sores.

After use every part of the table is scrubbed with soap and water, and when clean, usually wiped with an antiseptic, either carbolic 1 : 20 or formalin 2 per cent. In many hospitals the operating-table and the sterile tables are wiped with an antiseptic again before use. This is not actually necessary, since they are entirely covered by the sterile coverings during the operation.

The other tables considered necessary vary somewhat in different operating-rooms. One or two, according to the assistants available, are covered with sterile towels and kept "sterile" throughout. On these are placed the instruments, sutures, sponges, dressings, and all sterile appliances. Some surgeons use a narrow instrument table placed across the operating-table at a convenient height; in most cases an ordinary glass table is used, placed beside the assistant who is to hand the instruments.

Besides the sterile tables, one table is required for the anesthetist, one should be kept set out with the usual requirements for emergencies, and a third will be required for other articles to be handled by the unsterile nurse.

The **anesthetist's table,** which is placed at the head of the operating-table, should contain the following, all arranged conveniently:

The anesthetic to be used, as—

a. Ether and ether cone.

b. Chloroform in drop bottle and chloroform mask.

c. Tube of ethyl chlorid and square of folded gauze.

Tongue forceps.

Sponge holder.

Mouth-gag.

Gauze sponges.

Small towels.

Small jar of sterile vaselin.

Small jar of boric solution, 2 per cent., with eye-dropper.

Local anesthetics, such as Schleich's solution, cocain, eucain, etc., if required, should be ready in the hypodermic syringe in the dose ordered, or if required for an eye, in a small sterile bottle with the eye-dropper.

The tongue forceps are used to pull the tongue forward if it should drop to the back of the throat, especially in operations where the head cannot be turned to the side. The sponge-holder, with small gauze sponge, is to clear the throat of accumulations of mucus; vaselin is used to smear the lips, nose, and chin in giving chloroform, as if chloroform is dropped on the skin a burn will be produced; if the same accident happens to the eye, it is immediately irrigated with the boric-acid solution.

On the **emergency table** are placed the following:

Hypodermoclysis apparatus.

Flasks of sterile water or normal salt solution, both hot and cold.

Hypodermic tray.

Enema tube, funnel, and pitcher, with small bottle of whisky or brandy.

The oxygen apparatus stands beside the table.

The hypodermic tray should contain the hypodermic tablets most frequently required (atropin, strychnin, nitroglycerin, morphin, and cocain), two syringes ready charged, one with strychnin ($\frac{1}{30}$ to $\frac{1}{15}$ grain) and one with atropin ($\frac{1}{150}$ to $\frac{1}{100}$ grain), wrapped, until required, in a piece of gauze soaked in alcohol, a small flask of sterile water, a small bottle of alcohol, and a jar of sterile gauze sponges.

It is always a good plan that this table should be prepared as a matter of routine, if only because it familiarizes the pupils thoroughly with what is required in cases of emergency.

Reserve Table.—On a table, conveniently on one side, are placed reserve packets of sponges, towels, dressings, gloves, and gowns, to be unpinned and passed to the clean nurses or assistants, as required. On this table will also be placed bandages, pins, adhesive strapping, appliances, such as splints, tourniquets, extra pillows or sandbags, if likely to be required; dusting-powders, iodoform emulsion, and similar articles not constantly used. A

small tray with the necessaries for taking cultures (p. 372) should also always be in readiness, and may conveniently be kept on this table.

In some hospitals it is a routine practice to wash out the stomach after prolonged anesthesia, especially in abdominal operations. A large pitcher, a deep basin, and the stomach-tube and funnel should be prepared, together with any drug that may be ordered. Castor-oil (1 to 2 ounces) is frequently left in the stomach after the lavage.

Extra flasks of normal salt solution and of sterile soap, ether, and alcohol, and covered glass jars containing sterile sutures, ligatures, drains, and tubing, are conveniently kept on glass shelves or stands, either in the operating-room or close at hand.

Preparation Table.—It is often a convenience to arrange a separate table with the necessaries for the preparation of the area of operation. On it are placed flasks of soap, alcohol, ether, and the antiseptic solutions used, sterile basin and brush in wrapper, packet of sponges, packet of towels, razor, a pair of bandage scissors, and two pieces of rubber sheeting. For a vaginal preparation long sponge-holders and small sponges are added.

Cupboards, Stands, etc.—A closet at hand should contain a supply of blankets, ether hose and gown, pillows, pillow-slips, and hot-water bags. During an operation some blankets and a set of hose and gown should be kept on the steam-pipes or other hot place, as the patient should be returned to bed in warm, dry clothing.

The instrument cupboard, usually also at the present day made of glass, with a metal framework, should be arranged conveniently, instruments of one kind arranged together in orderly rows. No instrument wanting repair, and no old-fashioned instrument not commonly in use, should be kept in the instrument cupboard.

Separate stands, each to hold one large basin, are generally used for hand lotion or sterile water, as preferred. One is placed near the operator, and one by the sterile nurse or assistant. In some hospitals iron rings take the place of the basin stands, and are fitted into sockets on the sterile stands or on the walls. If desirable, these

rings may be sterilized with the basins, and the whole then handled by the sterile nurse.

Sponge Receptacle.—A special receptacle is kept for used sponges only. This may be a wire basket, slop bucket, etc. Some hospitals use a large bag of stout muslin tied to the four corners of the frame of a glass table or stand in place of the glass slab, by which means the bag is held conveniently wide open.

The **wash-stands,** whether in the dressing-rooms or operating-room, should be provided with liquid soap, sterile brushes, orange-wood sticks, and nail-files, one set to each basin. These are usually kept standing during the operation in an antiseptic solution—carbolic, 1 : 20, or bichlorid, 1 : 1000. A fresh set of brushes, etc., is put out for each operation. At hand are basins containing the lotion according to the formula used in preparing the hands.

Basins and Pitchers.—A sufficient supply of sterile basins, pitchers, and small bowls must be in readiness. According to the method by which they are sterilized these will be in cotton wrappers, or taken when required from the sterilizer in which they are boiled. A large sterilizer in which a number of vessels can be boiled at one time and kept until wanted is a great saving of time in an operating-room.

Water-supply.—All modern operating-rooms are provided with a generous supply of sterile water; generally the necessary sterilizers are placed near the operating-room, and in charge of the operating-room nurse. Care must be taken to keep a sufficient amount sterilized for all demands.

In many hospitals of quite modern construction all the water laid on in the pipes of the operating-room is actually sterile, and can be used for ordinary purposes (solutions, skin preparation, and so forth) directly from the taps. Fluid to be used for hypodermoclysis or irrigation of closed cavities must be further sterilized in the autoclave or by the fractional method.

We saw in the last chapter that surgical technic, as we

understand it today, usually calls for two pairs of hands, "clean" and "unsterile," thus doubling labor. In modern operating-rooms many devices have been introduced to obviate this necessity to a great extent.

Foot-pedals are used to turn on the water in wash-basins, etc., thus doing away with any need for touching taps. The water sterilizer may also be fitted in the same way. Large sterile glass jars are provided for the lotions, fitted with stop-cocks also worked by foot-pedals; these are placed on a glass bracket of suitable height. By these arrangements the sterile nurse can draw water and prepare the lotions without coming in contact with an unsterile object.

Where the dressings, etc., are put up in packets (or jars or tubes, etc.), an unsterile assistant is required to open the packets. In place of the packets large metal drums are provided, into which the dressings, etc., are packed and sterilized without the need for separate wrappings. The drums are placed on special stands in the operating-room, furnished with foot-pedals by which the lids of the drums are raised.

Generally, three drums are provided: one for the gowns, caps, and gloves, hand-brushes and nail-cleaners, and the covers for sterile stands; a second for sterile towels; and the third for dressings, including sponges, tubes of packing, etc., sufficient for a full day's operating. The sponges and dressings are tied with tape into bundles of a given number. A fourth drum is often provided, fitted with an electric heater in which towels and gauze pads to be used in walling off the viscera in certain operations can be kept sterile and hot, thus doing away with the need of wringing them out in boiling water.

From these drums the sterile nurse can help herself without assistance or risk of breaking her technic.

A large boiler in which all the basins, pitchers, etc., to be used are sterilized may be provided in the same way with a foot-pedal for raising the lid.

There remain only the jars in which sutures are stored, and the small flasks of soap, ether, and alcohol to be used

in the skin preparation. These are tightly corked with ground-glass stoppers, and are immersed in a disinfectant (formalin, 2 per cent.; bichlorid of mercury, 1 : 1000, etc.) for at least one hour before they are to be used. A glass graduate, to be used in measuring the solutions, is prepared with these bottles. In an operating-room fitted in this way one " sterile " nurse can set out the entire operating-room for whatever number of operations, in a very short time, without requiring the help of an unsterile assistant, as she must do if packets, etc., are to be opened.

Mops.—The last item of equipment to be remembered is a mop, with which, from time to time, to wipe up the floor and keep it from getting greasy and slippery. This should stand on one side, in a bucket of disinfectant, usually carbolic 1 : 20. After use it must be well washed in hot soap and water and dried in the open air and resterilized.

Gowns.—A special uniform is usually required in the operating-rooms. The nurse's consists of a skirt and loose, short-sleeved blouse of unbleached muslin. The skirt is short—about eight inches from the ground. For the doctors a loose, short-sleeved shirt and trousers of the pajama shape in the same material are provided. These uniforms are clean, but not sterile. Over these uniforms, during the operation, is worn the usual sterile *gown*. The gown is not put on until after the hands are scrubbed up. Most of these gowns are made with long sleeves, which, at the wrist, are tucked inside the cuff of the rubber glove. The hair is also covered with a sterile cap. The operator and his assistants also frequently wear sterile gauze masks during the operation, and have the beard tied up in sterile gauze. If this is not done, it is the duty of an "unsterile " nurse to wipe the faces free from perspiration from time to time with a sterile towel.

Patient's Dress.—In most hospitals a special dress is provided for the patient during operations. This usually consists of jacket and hose of Canton flannel or other warm washable material. The jacket should be roomy and long enough to reach below the hips; it is fastened behind with a single button at the neck. The hose are made like

loose, roomy stockings, and reach to the hip. Jacket and hose are kept on during the operation, unless they are in the way of the part to be operated on.

The **linen supply** necessary for each operating-room includes the following:

Doctors' suits, gowns, and caps. } In heavy unbleached
Nurses' dresses, gowns, and caps. } muslin.

Sheets for the operating-table.

Pillow-slips.

Towels (dressing, used sterile).

Hand-towels.

Wrappers for sterile dressings, etc. (double fold of unbleached muslin).

Ether jackets and hose.

The stock cupboard should also contain hot-water bags with washable covers; rubber bathing caps, to protect the patient's hair in operations about the face, etc.; rubber bandages; tourniquets; and various pillows of different shapes and sizes, some stuffed with hair and others filled with sand. These are required in keeping a patient in a fixed position during an operation; they should be covered in rubber sheeting. Pillows of bolster shape, about 18 inches long, firmly stuffed with hair, are convenient to place under a patient lying on his side in certain operations, such as on the kidney or on the spine. To these may be added the foot-rest and pelvic rest described in the chapter on Bandaging. A hot closet in which blankets can be kept is a helpful addition to the operating equipment.

DUTIES OF THE NURSES

It is not possible to lay down any fixed rules as to the duties of the nurses in an operating-room: they vary with the number of assistants and with the facilities of equipment. The minimum assistance required at an operation under aseptic methods is one " clean " assistant and one unsterile; this does not include the anesthetist. In a hospital operating-room three nurses is often a practical number, a head nurse permanently in charge, and two

pupils. During the operation one pupil, or both if required, remains clean. It is usually best that the head nurse remains free to supervise and direct the pupils, to see that everything required for the succeeding operations is prepared in time, and to keep watch that no one breaks the technic. In small hospitals, however, she may be the only one actually attached to the operating-room, and frequently called upon by the operator to act as a second surgical assistant in minor details, such as sponging, holding the retractors, etc. In these circumstances the charge nurse should be "clean," as she must accustom herself to the methods of the different surgeons, who must also feel that she can be relied on to understand what is required—a confidence naturally not extended to the transient pupil. In order to get the necessary training, the pupils in turn must also act as "clean" nurses and help her in her duties.

The *clean* nurse usually has charge of the sponges, towels, dressings, ligatures, sutures, and needles. These she arranges after she is *clean*, on a table previously covered by a sterile towel, taking them from the packets, jars, etc., opened by the unsterile nurse. The instruments may be in her charge also, arranged in a convenient row on her table, and handed by her as required. The instruments are brought to her by the unsterile nurse in the tray in which they are sterilized. If two nurses are *clean*, the junior may be given the sponges and dressings as her care, and the senior the instruments, ligatures, sutures, and needles.

The **instruments** are often regarded by nurses as a special bugbear, and much needless anxiety is caused by leaving the pupils vague as to the uses of the different instruments and the special requirements of the different operations.

In hospital work the operating-room staff should be provided with a book in which the instruments, special needles, and the kind of sutures required for each kind of operation are clearly listed. At the same time the charge nurse should go over the instruments in the instrument

closet with each pupil, grouping those required for special work together. Many instruments are called by special names, usually after a surgeon who has added some improvement to the instrument. With these also the pupil must be familiar, as there is nothing in the name to suggest whether the instrument may be a needle-holder, a retractor, or something widely different, and she finds herself at a loss if it is asked for by its special name.

The Clean Nurse.—The routine duties of the clean nurse (or nurses) consist in passing the sterile objects mentioned as required, and in keeping the sterile area surrounded with sterile towels. She must keep close watch that she touches nothing unsterile.

She may be called upon, where there is not much assistance, to prepare the area of operation. This she usually does after she has prepared her hands by formula, but before putting on her gown and gloves. After the preparation she again sterilizes her hands and puts on her gown and gloves, while the assistant operator repeats the disinfecting part of the preparation.

If there has been no previous preparation, the patient is shaved and the whole process completely carried out once by an unsterile assistant or nurse before it is touched by any one *clean*.

During the preparation rubber sheets are placed one above and one below the site of operation, to protect the coverings, and are removed when this is complete.

The Sheet.—The preparation complete, the clean nurse arranges the sterile coverings. During the operation patient and table are covered with a sterile "operation" sheet. A proper operation sheet is cut one yard longer than the table and one yard wider; three-quarters of a yard from one end an opening is fashioned, either square or oval, usually eight inches long by six wide. The sheet is arranged so that the opening comes exactly over the site of the operation. Practically the operation sheet is found inconvenient if the table has to be rearranged during an operation. Usually a large sheet to cover the lower half of the table and patient, and a smaller sheet laid across the

upper part of the patient's body, is found a more convenient arrangement.

The sheets must be adjusted to suit the operation. For example, for an abdominal section the upper margin of the lower sheet is turned over and under the edge of the covering blanket at the pubes, and the lower margin of the upper sheet in the same manner over and under the patient's upper garment, about the tip of the sternum. The immediate sterile area is arranged above the sheets; usually it is made with four sterile towels arranged symmetrically round the site of the incision. To prevent the towels slipping they are either pinned together or held together with clips; the towels are changed from time to time during an operation by the sterile nurse.

The sterile area in operations on the vagina, perineum, rectum, etc., with the patient in the lithotomy position, is a little more difficult to arrange. A Kelly pad is placed under the pelvis, and over it a sterile sheet covering the lower end of the table, and gathered into a sterile bucket on the floor; each extremity is wrapped in a sterile sheet,and and a corner of each brought over and pinned together above the pubes; a fourth sheet covers the patient and table above, overlapping the side sheets at the pubes and thighs. The immediate area is covered by four sterile towels previously pinned together to leave the necessary opening. The *clean* nurse should keep one or two reserve sets of towels pinned in readiness, as it is difficult to adjust them separately in this position without slipping.

If a nurse has to remain *clean* for a second operation, her duties end when she passes the sterile dressings. The dressings are kept in their wrappers until actually required. If the case has not been perfectly clean throughout, she is required to change her gown and gloves and prepare her hands again by formula. Otherwise she stands aside and waits until the unsterile nurse brings her the fresh packets of towels, sponges, etc., and the instruments for the next operation. In an active operating-room the tables are, for the different operations, usually prepared beforehand, and brought into the operating-room with the fresh case. If possible, the pupils should then act as *clean*

nurse in turns, thus avoiding delay and also mitigating the fatigue.

The Unsterile Nurse.—On the unsterile nurse devolves the placing of the patient in the required position on the table, the adjustment of the table at the proper angle, and the arrangement of the unsterile coverings.

Position of Patient.—The patient is usually fully anesthetized when brought into the operating-room. In placing him on the table, the nurse must take particular care to adjust the pads or pillows so as to protect bony prominences from contact with the hard surface of the table, or the prolonged pressure involved may be the starting-point of a bed-sore.

The usual position of a patient under ether is on the back, the body fully extended, and the head turned to one side. The body, except the part to be exposed, is covered with a woolen blanket well tucked in round the lower limbs. A single light blanket may be thrown across the chest—generally the ether jacket is sufficient covering. The jacket should be unbuttoned at the neck before the anesthetic is begun. The ether hose are kept on, except when a lower limb is to be operated on.

The Patient's Arms.—Different methods are employed for keeping the arms at rest and out of the way, especially in operations on the abdomen. Many cross the arms on the chest and fix them by turning the lower margin of the jacket over the arms and tucking the ends firmly under the body. Others consider that the arms crossed on the chest impede, to some extent, the breathing, and keep the arms extended on either side. As the table is narrow, it is necessary to fix the arms, or a slight movement may cause them to roll over the side of the table and perhaps be injured.

One method is as follows:

Lay a draw-sheet across the table, so that it will lie under the patient's body, reaching from the axilla to the hips; the arms, fully extended, are laid close to the sides. Bring the ends out on either side, between the chest-wall and the arms.

Turn the ends over and under the extended arms, and tuck them back well under the patient.

In tucking, leave a few inches of the margin hanging out; with one quick pull on the free margin the arm is instantly freed.

Patients may also require to be placed in the lithotomy position, with the knees flexed, as described, with the crutches, in the Trendelenburg or Sims' positions (Chap. VI), on the side, or with one or other limb extended on a separate attachment of the table. A nurse often finds the arrangement of a patient in his unconscious condition one of her most difficult duties; she should be given the oppor-

Fig. 170.—Showing method of fixing arms during operation.

tunity to practise until she can do it deftly, and carry out any change of position during the operation without unduly disturbing the operation or coming in contact with sterile objects.

The patient in place, she next arranges the rubber sheeting, one above and one below the site of operation, removes the bandage and top preparation dressing, and waits on the *clean* assistant as she prepares the area.

During the operation she must be on the alert to forestall the wants of the operator or his assistants or of the clean nurse; she changes the lotions, keeps up the supply of towels and sponges, sterilizes instruments that may be

called for, and performs any service about the table for which an unsterilized pair of hands may be required. She is expected to keep close watch that technic is not broken, and to call the attention of one of the assistant operators to the fact in the event of its occurring.

In **emergencies** she may be required to administer a hypodermic, to prepare for hypodermoclysis, or to give a stimulating enema. If hypodermoclysis is required, she prepares the necessary apparatus, hands the needle and sterile length of tubing to the clean nurse, and prepares the skin for the puncture. When all is ready, the clean nurse removes her gloves and introduces the needle into the tissues, with the usual precautions; the rest of the process is usually left to the unsterile nurse, unless an extra clean assistant is available for the whole process.

If **irrigation** is necessary, the nozzle and a sterile length of tubing are brought to a clean assistant, the unsterile nurse preparing the rest of the apparatus. In connecting a sterile length to the rest of the tubing, which does not remain strictly sterile, she holds the end of the sterile tubing with a piece of sterile gauze. The unsterile length of tubing, either for hypodermoclysis or for irrigation, must always be sufficiently long to come well beyond the sterile coverings of the operating table. At the present day cavities are usually irrigated, when necessary, with normal salt solution in preference to sterile water or an antiseptic solution.

Where the **Paquelin cautery** (p. 105) is to be used, the unsterile nurse prepares the instrument, heats the tip, and manages the pump, passing the handle only to the operator, who takes it in a piece of sterile gauze.

Counting Sponges, etc.—One of the most important duties of the nurses during an operation where a cavity is opened is to keep count of the sponges and of the instruments used, especially of the artery forceps (clips, hemostats), of which a considerable number may be in use. Accidents have occurred in which a sponge or a pair of forceps has been left in the abdomen.

To facilitate the counting the numbers used must be known accurately. Sponges are given to the clean nurse

in packets of a known number, ten or twenty usually, and the forceps in bunches of six strung together on a safety-pin. On receiving the sponges the clean nurse counts them twice, and writes the number on a piece of sterile slate placed on her table. As the sponges are used and discarded the unsterile nurse places them on one side and recounts them, entering the number in tens or twenties in writing. Before the cavity is closed, the two counts are taken and compared, to insure that no sponge is left in the cavity. The same care is taken with the instruments. If an instrument falls fron the table or becomes otherwise unsterile, it is either resterilized and returned to the clean nurse for use again, or put on one side, to be counted with the instruments. It is usually a rule, in such cases, that no sponge or instrument put out for an operation may be taken from the operating-room during the operation. The nurse must never hesitate to notify the operator before he begins closing the wound if she finds herself with a sponge or instrument short. The operation is then stopped until the missing article is found.

Some surgeons have the sponges for abdominal sections made after special patterns, to lessen the risk of such an accident. Some use wide strips of gauze, about two yards long, folded so as to avoid raw edges, and rolled like a bandage; others have special pads of gauze made to which a length of tape is sewn; a pair of artery forceps clipped to this tape acts as an additional guard. Once a piece of gauze is saturated with blood, it may easily be lost sight of among the tissues and get buried under a coil of intestines or other viscera.

When the incision is closed, instruments and soiled towels are removed and the skin cleaned and dried before the dressings are applied. The dressings should not be taken from their coverings until immediately required; there is no object in leaving them uncovered on a table during an operation that may last an hour or more.

The dressing applied, the unsterile nurse may be required to help in the adjustment of the bandage and in drying the patient and removing him on to the stretcher. Particular care should be exercised in drying the back thor-

oughly. The covering blanket must be changed if wet, as it is important to return the patient to bed in warm, dry clothes.

One nurse should always accompany the patient with the anesthetist to the ward, where she should give the head nurse a written memorandum of any emergency treatment that has been necessary during the operation; thus:

11 A. M.: Hypodermic strychnin sulphate, $\frac{1}{30}$ grain.

11.15 A. M.: Hypodermoclysis normal salt solution, 500 c.c.

These are entered on the special chart (p. 175); nothing of this sort should be left to the spoken word—memories are too uncertain. She should also mention briefly anything that has been done other than the operation for which the patient was prepared.

Between operations the unsterile nurse removes soiled things from the operating-room, places stained instruments to soak in cold water, wipes the table, if the same is to be used again, with a towel wrung out in the antiseptic preferred, mops the floor, changes the lotions, water, etc., and replenishes the different tables with all that is required, bringing, as before, the sterile towels, sponges, etc., to the clean nurse in their packets, and the freshly sterilized instruments in their tray.

In all large schools many of the duties assigned to the unsterile nurse are performed by orderlies. The more, however, a nurse does herself of the actual work, just so much the more thorough is her training.

OPERATIONS IN THE PATIENT'S HOME

A very large proportion of a private nurse's work at the present day is surgical. Frequently she is called upon at short notice to prepare for an operation. The preparation will include not only the patient, with the details of which process she is familiar, but the preparation of the room and the operating-room equipment. For the former she will receive definite instructions from the surgeon; for the latter she may find herself left altogether to her own ingenuity, and must be prepared to arrange a modern operating-room from furniture, utensils, etc., intended for

entirely alien purposes. As a rule, nurses enjoy this part of the work, and it is more necessary to warn them against unnecessary extravagance in their demands than to suggest ways in which what they find to hand can be transformed into the requirements of the occasion.

Requirements.—In order that nothing may be overlooked, the best surgical nurses invariably keep a list of what is necessary to prepare, so easy is it, in trusting to the requirements of the moment, to overlook something essential.

The instruments the surgeon brings with him, and the anesthetist, as a rule, provides the anesthetic and the cone or mask.

In a city a nurse will be able to hire, if desired, sterilized dressings, towels, gowns, and utensils from one or other of the nurses' registries, giving notice of what she requires in good time. In many circumstances this is, however, out of the question, and she must prepare and sterilize everything herself on the spot.

The dressings and the solutions required are generally ordered especially for the occasion from a drug-store or surgical supply place. If the ordering is left to the nurse, she should be careful not to order more than will be used. One dozen tabloids of bichlorid of mercury will make six quarts of solution 1 : 1000; if the Kelly preparation is to be used, one ounce of permanganate of potash crystals and four ounces of oxalic acid crystals will be sufficient. A pint of alcohol (90 per cent.) may be ordered, as what is not used in the preparation of the skin and the sterilizing of knives and needles may be used later, diluted one-half with water, for the alcohol rubs.

Gauze and cotton in sterile packets from the drug-store are expensive items; where expense is a consideration, they may be bought by the pound and by the yard unsterilized, cut into the necessary dressings and sponges, and wrapped in improvised covers for sterilization. The nurse should ask especially for the oldest linen, old sheets, table-cloths, towels, and dusters, etc., or old discarded cotton clothing that may be cut up into wrappers and towels. Besides the dressings, the nurse must sterilize

a good supply of towels, a couple of sheets to cover the patient and table during the operation, and covers for the sterile tables.

Outfit.—Many nurses in their outfit provide themselves with the following articles, the cost of which is trifling when weighed with the convenience of having them always at hand:

Gown and cap.

Gloves, rubber and white cotton.

Nail-brush, file, and orange-wood sticks.

Hypodermic syringe and two needles.

Scissors, probe, and dressing forceps.

Rectal tube and funnel.

2 glass catheters.

Hypodermoclysis needle, with rubber tubing and glass siphon tube.

6-ounce bottle of concentrated sterile salt solution (the cork of ground glass).

Tabloids of bichlorid of mercury.

Bottle of alcohol.

Sterile packets of gauze and cotton (small quantities).

One or two bandages and safety-pins.

To this list a small portable instrument sterilizer and alcohol lamp are often added. What may be used for one patient can be paid for at cost price and replaced.

Hypodermoclysis is such a common form of treatment in all conditions of lowered vitality that the means for hypodermoclysis should be at hand, at all events in major operations. If normal salt solution is desired, it can be procured in special sealed sterilized flasks put up with tubing and needle complete. The nurse has merely to bring the solution to the required temperature by placing the flask on a gas-ring or in a hot-water bath. Where she has to prepare the solution herself, she will probably be unable to sterilize either by the fractional method or by steam under pressure. (See Salt Solution, p. 436.) The flask she is to use should be washed clean of dust or foreign particles and sterilized by boiling for half an hour. The water should boil actively for twenty minutes in a kettle used only for water before the salt

solution (or salt) is added; the solution is then filtered through several folds of sterile gauze until absolutely clear, poured into the sterile bottle, and placed in a water-bath to boil again for half an hour. The solution can be siphoned directly from the bottle, using a sterile glass drinking-tube as a siphon, to which the rubber tubing and hypodermic needle are attached.

Sterilizer.—The ordinary clothes-boiler makes a practical sterilizer for dressings, towels, etc., as already described (p. 425). These should be sterilized, when practical, the day before the operation, the packets dried off in the oven or on the hot-water pipes, and wrapped until required in a clean sheet. The basins and other utensils to be used may be boiled in the clothes-boiler for half an hour and kept in the boiler, closely covered until required. If this is impractical, they should be thoroughly scrubbed and immersed in an antiseptic (formalin, 2 per cent.; carbolic, 1 : 20; or bichlorid of mercury, 1 : 500) at least a full hour before the operation. The bath-tub or a good-sized laundry tub can generally be used for this purpose. The nurse should sterilize a couple of basins for hand lotion, a couple of pitchers for sterile water, etc., and two or three smaller basins or bowls for various uses. A flat pie-dish is a useful substitute for a kidney-shaped pus-bowl, and a soap-dish, a convenient size to provide for the anesthetist's table. A graduate measure or a small pitcher of known capacity for measuring solutions should be included. A couple of buckets, slop-jars, or a good-sized tub should be scrubbed clean to collect used sponges, etc.

Sterile water will be required, both hot and cold. Boiled water, kept in the receptacle in which it has been boiled, is generally accepted as sterile. Time must be allowed for one kettleful to be quite cold by the hour of the operation. To cool a kettleful quickly, stand the kettle in the sink, the lid in place, and let the cold water run over it.

Room.—The nurse frequently has the responsibility of deciding upon the room to be used for the operation and selecting the furniture. Remember that what the

surgeon wants chiefly is a *good light*, a *steady table*, and *no dust*.

A room that is too sunny is almost as great a disadvantage as a room that is too dark; for this reason a south room is, speaking generally, to be avoided; a north room with a good window is the ideal choice, a north light being always clearer than any other; for a morning operation a west light is practical, or an east room if the operation is in the afternoon. If the window is overlooked, the glass may be made opaque by rubbing over with soap, or a piece of mosquito-netting may be tacked tightly across. This should always be done if, as in the heat of summer, the window is to be open and is not already screened, and is especially necessary in cities, where the air is grimy and dust-laden.

That the room should be absolutely clean, a nurse will recognize as a first essential. If she arrives at least a full day before the operation, she has time to make it so. All hangings, curtains, carpets, pictures, and movable decorations should be removed, the walls and ceiling swept down, the floor and woodwork washed. If, however, she arrives only the morning of the operation, a strenuous cleaning will only set dust floating in the air. Usually some one will be available to wash the floor, and the nurse must be content with removing the hangings, carpet, lighter furniture, and wiping everything within reach with a cloth wrung out with a disinfectant.

Where it has been possible to prepare the room the day before it is an excellent plan, especially if the walls are papered, to disinfect by some simple means, although this is not as effective and must not take the place of thorough cleaning. A sheet wrung out of formalin, 10 per cent., may be hung over a screen, and a basinful of the same solution be sprinkled with a clean whisk over the room. Doors and windows are closed for six hours, after which air is admitted freely through the *screened* window. If the case is not "clean," the process may be repeated after the operation before the room is again used by the family.

Other considerations will also influence the choice of the operating-room. The room should, unless in a house

with an elevator, be on the same floor as the patient's bed-room; it should be as quiet as attainable, and especially removed from the noise of streets or the shaking of passing trains or cars.

To equip the room for an operating-room, the nurse will get ready an operating-table, a "sterile" table, a reserve table for pitchers, water, lotion, and unsterile objects, a couple of small tables, stools, or chairs, one for hand lotion, and one for the anesthetist, also a chair for the latter; a wash-stand for the surgeon to prepare his hands is added, unless a bath-room is available.

Table.—The solid, narrow, old-fashioned kitchen table makes the best operating-table, or a well-made dining table. If no table long enough is available, two of the same height can be tied together firmly by the legs.

To protect the table from staining, it should be covered first with a rubber sheet. The oil-cloth often used in country kitchens as a table-cloth makes a practical substitute for a rubber sheet if one is not procurable; failing this, several thicknesses of newspaper will answer the purpose. The pad is made of a blanket folded to the exact size of the table; this is covered with a second rubber sheet, and the whole folded tidily in a sheet. To prevent slipping, the pad should be secured to the table with strips of a wide bandage passed over the pad and tied below the table. A clean old blanket will be necessary to cover the patient, and a couple of small sheets should be sterilized to use during the operation.

Position of Patient.—If it is necessary to place the patient in the Trendelenburg position, a chair may be placed on the table, as described previously (p. 194), and the whole covered with the operating pad. In order to raise the table, either the whole or one end, blocks may be made of bundles of magazines tied firmly in packets and covered in newspapers or old towels, or hassocks may be wrapped in newspaper or covered with old towels.

If the lithotomy position is required, the patient is brought to the bottom of the table, the legs elevated and separated, the knees flexed, and the feet made to rest on a couple of small tables or high stools, placed beside the

bottom of the table. The feet are tied in position with a wide bandage. The position may also be kept by tying each ankle to the wrist on the same side. This is, however, an awkward method if it should be necessary, as in an emergency, to alter the position of the patient suddenly. All the tables should be protected by newspapers of several thicknesses, covered with a clean towel. If the furniture is polished, ask for some plain wooden boards to cover those on which lotion, water, etc., are to be placed; an ironing-board makes an excellent stand for pitchers of hot water and lotion bowls.

To protect the floor, unless a large rubber sheet is available, it may be covered with several thicknesses of newspapers, over which a clean old sheet or curtain is stretched and tacked down. Unless the floor is of brick or stone, special attention should be paid to this part of the preparation. Blood-stains are very unsightly, and are difficult to remove entirely from wood, especially unvarnished wood. In country homes a piece of tarpaulin can generally be procured for the purpose; it must, of course, be absolutely clean.

Sterilizing Instruments.—The instruments can be boiled in any vessel of convenient size, provided with a lid; they should be placed first on a flat pie-dish or cake-tin, in which they can be removed without handling the instruments. A small fish-kettle, with its movable perforated tray, makes a perfect instrument sterilizer, and can be boiled on the kitchen stove. A small flat dish should be sterilized and filled with alcohol for the knives and needles, as it is frequently preferred not to boil them (p. 455).

Arrangement of Room.—The sterile table, covered with a sterile towel, is placed beside the surgeon's assistant, and on it are arranged the instruments, needles, ligatures, sutures, and sponges; the latter counted and the count written down.

On the unsterile table are the packets of dressings, towels, gowns, etc., the pitchers of water and lotion, the latter covered with a towel wrung out of the antiseptic solution, the requisite for the skin preparation, the salt solution, bandages, pins, etc.—all that is to be handled by

the unsterile assistant. A watch or clock, and a pencil and paper should not be forgotten; any special treatment should be noted in writing.

The stool or chair for the hand lotion is also covered with a sterile towel and placed close to the operating surgeon; if a chair is used, the back is also covered; the gloves can be placed in this lotion.

The anesthetist's chair and small table are placed at the head of the table. On this table are placed a soap-dish, a sterile glass containing sterile water, a second with a little alcohol, some squares of old clean linen or cut gauze, the hypodermic tabloids, and a hypodermic syringe, sterilized and wrapped in a gauze sponge soaked in alcohol. The anesthetic and apparatus are usually brought by the anesthetist, who will also probably have with him the usual hypodermic tabloids.

If **irrigation** is to be expected, a Kelly pad or its equivalent must be prepared. A rubber sheet, or, failing this, wax cloth may be used. At one end is placed a lightly rolled small blanket (or newspaper, etc.), and the rubber is rolled over the blanket for about a third of its length, forming a little bolster. The bolster is bent round like a horseshoe, and forms the pad, the free part of the sheet forming the apron.

On the floor may stand conveniently the kettles of hot and cold sterile water, the tub or wash-boiler with the sterilized basins and bowls, and a slop-jar for the used sponges.

Gowns.—A nurse who is doing surgical work will have an operating gown and cap in her outfit. In an emergency she can sterilize a large gingham apron and simple cotton blouse with the dressings, and cover her head with a sterile towel. A sheet also can be converted into a fairly practical sterile gown, either for herself or the surgeons. Before sterilizing, the sheet is folded so that the two ends come together at the back, allowing sufficient space for the neck; the upper margins are then pinned together closely with safety-pins (or stitched together) over either shoulder and the upper part of the arm, leaving enough room for the arms to be thrust through, much after the

manner of the Greek dress. The impromptu gown is pinned behind at the neck, and if too voluminous, may be tied round the waist with a sterile bandage.

For carrying a patient to and fro, a light rattan porch couch may be available, or a stretcher may be improvised in several ways. The patient is carried feet first.

A couple of plain, high-backed chairs may be tied together firmly, the back of one overlapping the back of the other; on this two or three cushions are laid, on which the patient lies flat, the legs of the chair forming the handles of the stretcher. This stretcher is too short for the patient's legs, which are thrust through the arms of the foremost carrier; in many homes it is impossible, however, to get a longer stretcher through the narrow doors and landings.

A stretcher may also be made out of a couple of stout sacks, such as are used for flour or potatoes, and a pair of light curtain-poles; at either end a walking-stick is firmly tied to each pole, to keep them sufficiently apart. Where no stretcher can be contrived, the patient may be carried in his sheet, one carrier at the head, one at either side, and one at the feet.

Frequently the patient is nursed afterward in the room prepared for the operation, and is then easily lifted from the table to the bed. If his former bedroom is on the same floor, he may in many cases be allowed to walk to the operating-room, or be carried in the upright position. A carrying chair is easily made from a piece of strong ticking cut the shape and size of the seat of an ordinary chair; the sides are strongly stitched with wide hems, through which short stout poles are thrust. This is a comfortable way of carrying a patient, and can be taken up and down a narrow staircase much more easily than any ordinary carrying chair.

A nurse who knows exactly what she requires will be able to set available members of the family to help in preparing the room, etc., while she is busy with the patient, who may often leave her time for little else. She will generally find they are thankful to have something definite to do to keep their thoughts from the ordeal before them.

In the houses of the wealthy the nurse will have little

trouble. The surgeon in a wealthy practice usually has his own operating nurse, trained exactly in his ways, who brings with her all that is required, even to a portable operating-table. It is in the homes where expense is a consideration that she will most often have to exercise her ingenuity. She should make it her pride, as well as one of her special duties, to reduce her requirements to a minimum. We often see at the present day "demonstrations" given to pupil nurses on the subject of preparing an ordinary room for an operation. The ingenuity shown and the dainty effect produced are certainly to be commended, as well as the excellent technic practised. One remembers a demonstration where it was recommended to hang clean sheets round the walls from the picture-line; where the backs of chairs were encased in pillow-covers, and numerous sheets and table cloths used skilfully to cover all the necessary furniture. The effect was produced at the cost of a very large laundry-bill, and nothing but effect was really gained. No sensible woman would do anything but censure such needless extravagance, and one would beg nurses to realize that it is by such thoughtlessness that they are among so many a byword for extravagance, and their presence so often looked upon as an intolerable burden.

After the operation the nurse will necessarily be occupied entirely with her patient for some hours, and unless the operation is performed in the patient's own room, she must leave clearing up until later. She should see, however, that all stained linen is placed at once to soak in cold water, and that the room is left in as little an unsightly condition as possible. A good training should teach a nurse to do all work in an orderly way, and to " clear as she goes."

The instruments she can take with her, usually, to the patient's room, removing the stains with cold water and drying with a little alcohol. The surgeon will generally get them cleaned and sterilized in his own office.

If a nurse intends to take up surgical nursing specially, she will be wise to spend some weeks in helping an experienced nurse in the preparation for operation cases, so difficult is it to realize conditions or imagine emergencies from any but the standpoint of experience.

CHAPTER XVI

THE CARE OF OPERATION CASES

Preparatory Period—Immediate Preparation—Ether Bed—After-care—Restlessness, Nausea and Vomiting, Thirst—Abdominal Section—Distention—Stercoraceous Vomiting—Shock—Hemorrhage—Sepsis—Care of Eye Operations—Tracheotomy—Intubation.

PREPARATION OF THE PATIENT

The care of operation cases, especially major operations, should begin, whenever possible, two days before the day of operation.

The Preparatory Period.—During the preparatory period all physical fatigue and mental excitement or worry should be avoided; to insure this, many surgeons, and especially gynecologists, keep the patient in bed and forbid all visitors for from twenty-four to forty-eight hours before the day of operation.

In hospital patients the heart and lungs are examined on admission as a routine duty, and a specimen of urine is saved for examination. These examinations are repeated on the morning of the operation; the patient should not be sent to the operating-room until the report of the urinary analysis has been returned (p. 246).

Catharsis.—If the patient has a history of constipation or other intestinal irregularity, some form of catharsis is begun at once. Many surgeons order a course of calomel as a routine treatment. In normal conditions, however, treatment is frequently not begun until the day before the operation.

According to the hour of the operation, a purgative is administered, either in the morning or the afternoon of the day before the operation. If the purgative does not act in six hours, the dose is either repeated or an enema is given to excite the peristalsis.

On the day of the operation, usually six hours before the time fixed for the operation, a copious enema of warm suds is given. This is repeated in two hours, and again if necessary, until the fluid returns clear, which is a sign that the lower bowel is empty. The purgatives preferred are salts of magnesia or castor oil, but some surgeons prescribe milder drugs.

For operations on the rectum thorough catharsis is especially essential. Treatment is begun at least forty-eight hours before the operation. For the twenty-four hours prior to the operation only liquid diet is given, and special care is taken in giving the enema to insure that the bowel is thoroughly emptied.

In operations for chronic conditions on any part of the alimentary tract, as, for example, in the radical cure for hernia, the same care is necessary.

In emergency operations thorough preparation is not possible. If *more than four hours* elapse between the admission of the patient and the operation, a suds enema may be ordered, otherwise the bowels are left undisturbed. An exception may be made in the case of injuries producing compression of the brain; in this case a drastic, quick-acting purgative, such as croton oil (1 to 2 minims), is frequently ordered. All nourishment is, of course, withheld.

In acute abdominal conditions, such as appendicitis, intussusception, obstruction, perforation, etc., no treatment of any sort is given without special orders. An enema may be ordered, but commonly even this is omitted.

The *diet* is nourishing and digestible, avoiding fried foods, coarse vegetables, and highly seasoned or rich dishes.

The patient is usually given his ordinary meals until the evening before the day of operation. On this evening a light supper is served, as, for example, a cup of clear broth, sweetbreads, oysters, or a soft-boiled egg, without vegetables, and a simple dessert. After this meal no solids are given, unless the operation is to take place later than 12 noon. In this case a breakfast of tea or coffee, roll, or a piece of toast and a soft-boiled egg may

be ordered. Four hours before the operation a small cup of hot broth or beef-tea is given, and nothing further.

The reasons for such preparation are readily understood. If food is present in the stomach, vomiting will occur. The convulsive retching accompanying the act interferes with the operation, and in some cases may actually be dangerous. At the same time there is risk of the vomited matter falling into the larynx and choking the patient. If the rectum is not emptied, the bowels will probably act when the sphincters become relaxed under the anesthetic, while, if the intestines are distended with food or gas, they are more liable to injury if the abdominal cavity is opened.

Cleansing.—During the preparatory period a hot tub-bath is given to the patient daily, taking special care to cleanse the area of the operation thoroughly. (For the local preparation see Chap. XIII.)

For an abdominal operation the nurse should herself examine the abdomen and make sure that the umbilicus is perfectly clean. If this is not the case, it should be well washed, and, if necessary, a small soap poultice applied. It is, however, always a disadvantage to irritate the tissues.

Immediate Preparation.—An hour before the operation the immediate treatment of the patient is begun. The temperature, pulse, and respiration are taken and charted. A woman has her hair brushed and braided in two plaits, which are pinned out of the way round her head. Any false teeth are removed. The clothing usually consists of the loose jacket and long hose of Canton flannel already described; in private work an old night-gown should be used, choosing one that is loose round the neck. For operations on the face, mouth, nose, etc., the hair is covered with a rubber bathing-cap.

A quarter of an hour before the time set for the anesthetic the urine is voided. If the operation is on the pelvic organs, the patient is usually catheterized, and a note to that effect made on the chart, with the hour and the quantity of urine obtained clearly stated. The charts and history notes generally accompany the patient to

the operating-room. In special conditions a stimulating enema is ordered to be given half an hour before the anesthetic is begun. In other cases a hypodermic injection, usually of atropin and morphin, may be given immediately before the anesthetic. These, as a rule, are special orders, and not part of the routine treatment; they must be entered on the chart before it is sent to the operating-room.

ETHERIZATION

For all major operations the patient is taken to the etherizing room on a stretcher; in some minor cases a wheel-chair is permissible; it is undesirable that a patient should walk or stand immediately before taking an anesthetic.

It may be necessary to etherize the patient in his own bed. As the bottom rail is usually lower than the head-rail and stands free from the wall, the patient lies with the head at the bottom of the bed, a single pillow under the head.

Until the patient loses consciousness, the struggling movements are merely guided to prevent the patient injuring himself, and no force is used. During the few moments when consciousness has been lost, and before relaxation has set in, considerable strength is frequently necessary to control the patient and prevent his injuring himself.

The greatest quiet should be maintained during the giving of an anesthetic. The patient's hearing is preternaturally acute, and his nervousness is much increased by chance noises or talking. At the same time he is liable to misunderstand words that are used and take all remarks as allusions to his own condition, often working himself into a state of needless alarm. Irrelevant topics are obviously out of place, and rightly construed as heartless and undignified.

The ward nurse usually remains with the patient until he is placed on the operating table in the required position. She should see that the pads or pillows are adjusted to prevent his back being injured by pressure on the table. In the ordinary position the lower half of the body is wrapped in a warmed blanket, over which a rubber sheet is

tucked until after the cleaning-up process is finished, when it is replaced by the sterile sheets and towels.

Records of the pulse, respiration, physical treatment during an operation, and some details of the operation are kept by the anesthetizer, and are not usually the responsibility of the nurse. In small hospitals, however, where there is not much assistance, the care of the pulse is sometimes given to a nurse. In this case she should realize the importance of her responsibility, and not for one moment let her attention wander from her special duty to the details of the operation.

Fig. 171.—Ether bed No. 1: A bed arranged for return of a patient from operation.

The Ether Bed.—As soon as the patient has been sent to the operating-room, the bed is stripped, the room aired and put in order, and the ether bed is made up.

A full-length rubber sheet is spread over the mattress and on the top of this the under sheet; on the top of the sheet a cross rubber sheet and draw-sheet. A clean towel is laid in place of the pillows, which are removed unless, as in some head operations, orders are given to the contrary.

Three or four cans filled with boiling hot water are

placed on the bed and covered with a blanket. *These are removed before the patient is placed back in bed.* The upper coverings, sheet, blanket, and spread, are smoothly rolled together to one side. An extra blanket and a couple of hot-water bags should be in readiness in case of emergency. A towel is hung over the bed-rail, and on a table by the bed are placed a small shallow basin and a packet of gauze sponges.

Fig. 172.—Ether bed No. 2: The same, with the bottom elevated.

Collapse.—In cases of collapse the lower end of the bed is generally elevated. As this emergency is always liable to occur, many hospitals finish the preparation of the ether bed by securing a firm hair pillow upright against the head railing. A draw-sheet placed over the pillow and pinned behind the bed-rail keeps the pillow in position. By this arrangement there is no danger, if the lower end of the bed is raised, of the patient's head slipping through the rails.

IMMEDIATE CARE AFTER THE OPERATION

When the patient is returned to bed, the nurse quickly ascertains if any of the clothing is wet, and removes it if necessary. The blanket, warmed by the cans, is tucked

round the patient, and the upper covering unrolled and adjusted. Except in special conditions, the patient is laid flat on the back, *with the head carefully turned to one side.* This is in order to prevent the risk of vomited matter falling into the larynx and choking him.

It is a rule in most hospitals that no hot-water bags may be put into the bed of an unconscious patient without a special written order. If hot-water bags are ordered, they must be hot enough to give the warmth for which they are ordered, and are, therefore, hot enough to burn the patient should they rest against the skin. To prevent this, first, they must be securely covered; second, the patient's body must be protected by a light blanket, which must intervene between the skin and the hot-water bags; third, he must not be left one moment alone while the hot-water bags are in his bed.

Once in bed, the patient is left alone with his nurse. The room should be warm, between 70° and 80° F. (unless the contrary is especially ordered), the light shaded, and absolute quiet maintained. Fresh air should be admitted freely, avoiding a draught on the patient. No unnecessary talking should be allowed, and visitors and avoidable coming in and out forbidden. A note should be made on the record chart of the pulse, respiration, and the general condition of the patient immediately on his return from the operating-room. Thus:

Time.	Temp.	Pulse.	Resp.	......	Returned from operating-room. Sweating profusely. In good condition.
11.15 A. M.	.....	110	25		

However slight the operation, a patient must not be left alone until he is fully conscious and out of the influence of ether. As reaction sets in, some restlessness is sure to develop; the patient throws himself about and frequently tries to get out of bed, and if left to himself, may seriously injure the parts freshly operated on, strain the stitches, and possibly cause a hemorrhage. As consciousness returns, vomiting occurs. If the nurse is not at hand to keep the head turned to one side, there is risk that the vom-

ited matter may fall into the larynx and cause fatal asphyxia. Further, in all operations there is risk of shock, the first symptom of which must be appreciated. In ward cases it is usual to isolate major operation cases for the first twenty-four hours after the operation, most surgical wards having a room or rooms reserved for the purpose. If the construction of the hospital does not admit of this arrangement, the space round the bed should be screened off, in order to insure as little disturbance as possible.

The pulse and respiration must be closely watched. The pulse is the most important indication of the patient's condition after any operation. Under the anesthetic both pulse and respiration become considerably raised; as reaction sets in the pulse should become steadily slower, and at the same time the respirations gradually return to normal. A good pulse, steadily below 80, is the best sign that the patient is in good condition.

Any quickening of the pulse is a significant symptom. It may be due to an attack of vomiting, sudden disturbance or restlessness, in which case the condition is only temporary. A pulse that becomes *suddenly soft, small, and rapid,* is the first symptom of hemorrhage, and frequently, to inexperienced eyes, there may be no other symptom of the condition (p. 581).

The first twenty-four hours after an operation is commonly one of extreme wretchedness, hardly made tolerable by even the best nursing. Its chief symptoms of discomfort are restlessness, nausea and vomiting, and thirst.

Restlessness.—Many surgeons keep their patients under the influence of morphin for the first day, and further, if circumstances require it. Others, however, condemn the practice as further upsetting the gastric condition, and running some risk, however remote, of establishing a habit.

Where it is essential to retain a fixed position, it may be necessary to restrain the movements by passing a sheet folded lengthwise over the lower limbs from the hips to below the knees; the sheet is secured with safety-pins to the frame of the bedstead. A second sheet may be necessary,

fixed in the same way across the chest, but leaving the arms free. In extreme cases ankle-straps and wrist-straps may be necessary. All these restraints, however, naturally tend to increase the nervousness, and should never be kept on a moment longer than necessary.

Where the position may be changed, it is comparatively easy to relieve the restlessness. In cases of abdominal section, permission is frequently given to mitigate the enforced recumbent position by a small flat pillow placed under the small of the back, and by flexing the knees over a pillow. The latter has also the effect of relaxing the abdominal muscles, and so relieving tension on the stitches.

Other means of soothing restlessness are sponging the face and hands with hot water, gentle massage to the calves of the legs, or an alcohol rub to all parts of the body that can be reached without moving the patient from the prescribed position. An ice-bag to the head or the back of the neck may also relieve restlessness and induce sleep, especially if, at the same time, a hot-water bag is placed at the feet. This treatment should not be used unless the condition of the pulse indicates that the normal condition of the circulation is reëstablished.

A cause of restlessness sometimes overlooked is the condition of the bladder. Usually, after abdominal section, an hour is set after which, if the patient has not voided, the catheter is passed. This is usually eight hours after the operation is over. In some cases, however, this may be too long to wait, and to empty the bladder at an earlier hour may considerably mitigate the restlessness.

Nausea and Vomiting.—Some nausea and vomiting almost invariably occurs after ether (unless with children, who frequently escape), and to a less extent may be expected after chloroform. After nitrous oxid gas there is usually no vomiting.

If the alimentary tract has been properly prepared, the vomitus consists of a little greenish fluid with a bitter taste, mixed with mucus and saliva. During the act of vomiting an unconscious patient must have his head turned forcibly to the side and the jaw pushed forward and up-

ward. This closes the epiglottis, and prevents the patient being choked by the vomitus falling into the larynx. The mouth is cleansed with pieces of gauze, either dry or soaked in water, to which a little listerine (or other mouth-wash) may be added.

After operations on the mouth, throat, nose, etc., especially such operations as for the removal of adenoids and tonsils, a quantity of blood may be swallowed, and is usually vomited as reaction begins. Many throat surgeons encourage vomiting in these circumstances by ordering the patient to drink water freely as soon as he is conscious. The water is cold or iced, in order not to encourage bleeding from the recent wound.

Some hospitals make a practice, in abdominal operations, of washing out the stomach before the patient is removed from the operating-table. Warm sterile water is used, and generally one to two ounces of castor oil is introduced after the lavage and left in the stomach.

Where there is much retching, there is some risk that stitches about the abdomen may be burst by the strain. To guard against this, the nurse should support the abdomen during the attack by placing her hands on either side and pressing, very gently, toward the incision.

For the first twelve hours little treatment is ordered for the vomiting. If the condition does not improve and the vomiting is persistent, treatment becomes necessary.

Hot stupes, a hot-water bag, or a mustard plaster may be applied to the epigastrium. Cracked ice is given to suck, though this has the disadvantage of increasing the thirst. Boiling hot water in sips is also ordered. Some doctors wash out the stomach by inducing the patient to drink a couple of tumblers of warm water, in each of which a pinch of bicarbonate of soda is dissolved; enough is taken to induce vomiting, and the stomach is thus washed out. Lavage may also be ordered in the usual manner. Where stimulants are permitted, an ounce of champagne or half an ounce of brandy may be poured over a glass of cracked ice and given in sips.

The position of the bed may also be a help. Usually it is best to keep the head low and the feet elevated;

if vomiting is persistent, the reverse may be tried, and is sometimes, apparently, successful.

Drugs that may be ordered to check vomiting are: *Cocain hydrochlorid* ($\frac{1}{8}$ to $\frac{1}{2}$ grain), cerium oxalate (1 to 5 grains), *bismuth subnitrate* (5 to 15 grains), and others. The *bromids* are sometimes given by rectum with good effect where the vomiting is due to the nervous condition. Hypodermoclysis, or intravenous infusion of normal salt solution, also has frequently the indirect effect of relieving the condition.

Thirst after an anesthetic is the symptom most trying to the average patient. It is chiefly due to the loss of fluid to the tissues caused by the necessary hemorrhage, and the sweating which a general anesthetic usually causes, but it is also to some extent the result of the irritation of the anesthetic.

Fluid may be restored to the body by enemata of hot water or normal salt solution, by seepage or constant rectal irrigation, by hypodermoclysis, and, in the severer cases of loss of blood, by intravenous infusion of normal salt solution.

In cases other than abdominal section the patient is usually allowed to satisfy the thirst. Very hot water, or hot weak tea, allays thirst more effectually than ice or cold drinks. Cold toast-water is often agreeable, and frequently also helps to check the vomiting.

Where the operation has not involved any part of the alimentary tract, the ordinary diet is usually resumed as soon as the gastric irritation due to the anesthesia has subsided.

ABDOMINAL SECTION OR LAPAROTOMY

Under the heading of abdominal section we have operations on any of the important organs reached by opening the abdominal cavity; in other words, by entering the *peritoneum,* the most important closed cavity of the body. This includes operations on both abdominal and pelvic organs; on the intestines—for hernia, intussusception, diseased appendix, perforation, or ulcerated conditions; on the liver and gall-bladder; on the stomach; on the pancreas; on the uterus and its appendages. The post-opera-

tive care of cases of abdominal sections forms the larger part of a modern surgical nurse's work, and it is of the first importance that she should be familiar with the routine treatment and recognize the earliest indications of untoward symptoms. While special conditions call for some modification of the treatment, the general care of the patient is similar in the large majority of abdominal sections, and to mention the operations separately would, in most cases, involve needless repetition. The *diet* may to some extent be varied with the different cases, especially in operations of the alimentary tract, but on this point the nurse will always receive definite instructions.

Position.—The strict recumbent position is inforced for a specified time. Usually each doctor has his own method. Some allow the patient to be turned for a short period on the second day; others keep the patient flat on the back for a longer time. The extent of the operation and the structures involved obviously influence the treatment.

The return to an upright position must be managed very gradually. One pillow is usually allowed as soon as the patient is out of ether, provided the pulse is below 80 and regular. A second is added for the daytime, perhaps on the fourth day, if the condition is good; later a third is added while the patient is taking his meals. After the stitches are removed the patient is propped up on a bed-rest at intervals and is gradually accustomed to the upright position.

Doctors differ greatly over the length of time the recumbent position should be inforced and the time the patient must remain in bed, but the modern tendency is generally in favor of returning to normal conditions as soon as possible, provided always that the condition of the heart is good.

The period of the strict recumbent position is the time when bed-sores may easily form (Chap. I). To prevent this the bed must be kept smooth, cool, and absolutely dry. If heat or pain in the region of the coccyx is complained of, the surgeon should be notified, and permission obtained, if possible, to vary the position. If not, it may be permitted steadily to raise the pelvis a few inches from the

mattress and rub the spot with alcohol, drying it off with powder. This is repeated constantly. To raise steadily, the nurse should rest her elbow on the bed and place the palm of the hand flat just above the coccyx.

The scultetus bandage, still in common use in abdominal surgery, is a prolific source of bed-sores. The lower margin becomes creased, soiled, or damp from perspiration, and if the nurse has orders not to move the bandage or turn the patient, a bed-sore may be extremely difficult to avoid. In many hospitals the scultetus bandage is replaced by strips of adhesive strapping, to one end of which tapes are sewn (p. 289). If a scultetus bandage is also used, it may then be changed or readjusted without danger of disturbing the dressings.

Drainage.—In operations on the bladder and in many on the gall-bladder drainage may be necessary, sometimes for a considerable time. To keep the bed dry and the patient comfortable, a bottle or jar may be attached to the bed-frame; in this is introduced a length of rubber tubing connected by a short glass tube with the catheter (bladder) or drainage-tube (gall-bladder) inserted at the site of operation. The vessel should be of glass, so that the contents may be seen. A strip of adhesive strapping attached to the outside of the bottle may be marked off in graduations, and forms a better guide than the eye of the amount passed from hour to hour. If the fluid is not flowing, the cause is usually a clot that has lodged in the tube. The lower tube should be disconnected and irrigated under the water-tap; if no impediment is found, the surgeon must be notified, as it then becomes necessary either to irrigate or remove the stationary tube. In order that a stoppage may be at once detected, the nurse should make a practice of examining the bottle at regular intervals.

Diet.—After an abdominal section it is necessary to keep the intestines at rest, so that the parts operated on may be undisturbed. Nothing, therefore, that may excite peristalsis or lead to the formation of gas must be given for a specified time.

The usual treatment is, after six hours, to give every hour teaspoon doses of boiling hot water; after twelve

hours, the amount is gradually increased. Patients frequently find it a relief to suck pieces of gauze soaked in lemon-juice and water. Some surgeons feed their patients entirely by enemata for the first forty-eight hours, and longer if nausea persists. Beef peptones, broth, meat-juice, raw egg and milk are administered in this way, and, if necessary, a stimulant is added. The enema should not exceed six ounces, and may be repeated every eight hours.

After twenty-four hours fluid nourishment is begun in small amounts. Albumin-water, liquid peptones, strained chicken or beef-tea, or, more rarely, milk, are given, beginning usually with half an ounce at a time, until it is seen what the stomach will retain. In operations on the digestive organs a longer period of starvation may be necessary. A restricted liquid diet is given until the bowels have moved, after which a soft diet is ordered, to which, gradually, solids are added, avoiding coarse vegetables and seasoned or fried dishes. While on a liquid diet, and until the patient can use a tooth-brush, the mouth must be carefully cleansed at regular intervals (Chap. I.)

Bowel Movements.—It is usual to induce an action of the bowels at the beginning of the third day after the operation: that is, at the end of the first forty-eight hours. Frequently a course of calomel is given, beginning twenty-four hours after the operation, followed by salts on the following morning; or a suds enema may be prescribed on the second morning after the operation. The nurse should always be able to report whether or not flatus has been passed by rectum, since this is an important indication of the condition of the intestines.

To induce a regular daily evacuation of the bowels is of the first importance, both during the critical period of nursing and throughout convalescence. When the period of strict starvation is over, the diet should be chosen to further this end. Raw fruit-juice in the early morning, meat extracts, thin oatmeal gruel, cream, all help and are usually preferred to milk, which in many patients produces constipation. If milk is given, it should be diluted or given in such form as junket, with cream, etc. (Chap. XXII).

The evacuations should be inspected, and in the case of operations involving any part of the alimentary tract, should be especially examined for any appearance of blood.

Visitors.—It should be remembered that a major operation must always produce some nervous strain, of which, while the patient is lying quietly in bed, there may be but little symptom. If the regulation of visitors is left to the nurse she should proceed very cautiously, noticing carefully the effect on her patient, and erring rather in keeping the patient too quiet than in risking excitement for which the patient may pay later. Usually the nearest relation is admitted for a short time on the third day, all being well, and one visitor a day only allowed, for a specified time, until the patient is sitting up in bed. It is always wisest to get definite instruction from the surgeon on this point.

Distention.—An untoward symptom of grave import in the nursing of abdominal sections is *distention*, or inflation of the intestines with gas. The condition is caused by intestinal obstruction; commonly it is a temporary (though serious) condition, due to gastric upset from the anesthetic, but occasionally complete obstruction may be present, caused by accidental twisting or other injury to a coil of intestine.

The nurse must be on the watch for the first symptoms of tightening of the bandage at the upper margin. The abdomen is swollen and more or less rigid, and the breathing shallow; no flatus is passed. The condition usually occurs early, during the day of the operation or the day after. At this time the patient's temperature is easily upset, and will probably rise together with the pulse, whether the condition is due to gastritis or to complete obstruction. If due to the latter, the physical symptoms will be intensified and the vomitus will probably become stercoraceous (p. 699), always a very serious symptom.

To relieve distention hot turpentine stupes may be applied to the abdomen and changed repeatedly, and the rectal tube be passed as high as possible up the colon. A hot suds enema may give relief (unless in operations on the

lower bowel), or medicated enemata containing either milk of asafetida, alum (carminatives), sulphate of magnesia, or castor oil (Chap. IV). All nourishment is, of course, stopped; the mouth should be washed out frequently.

Drugs that may be ordered by mouth are asafetida (tincture of, 5 to 20 minims), turpentine (5 to 10 minims, in capsule), and eserin, usually given by hypodermic ($\frac{1}{60}$ to $\frac{1}{18}$ grain). The two former have a carminative action; eserin has the property of stimulating the peristaltic action.

If there is stercoraceous vomiting, the stomach is usually washed out with plain sterile water, and nothing is given by mouth. When entire intestinal obstruction is present, a second operation will probably be necessary.

Still more serious is the true **tympanites**, when the peritoneal cavity becomes distended with gas. The condition is seen in general peritonitis, a complication which, if occurring after an abdominal operation, is very often fatal. It may be caused by infection at the time of operation, or may be due to accident, such as a decomposing blood-clot in the cavity, or the escape of the intestinal contents into the cavity from a perforation. This form of distention occurs usually later than the third day. The temperature will probably be high, and the pulse *quick, hard,* and *wiry;* as the condition advances the features are pinched and anxious, and the patient is frequently delirious. The bowels are constipated, or there may be total obstruction. The appearance of the distention and the characteristic hard, wiry pulse are the most easily recognized diagnostic points. In intestinal distention the swollen bowel may be felt through the abdominal wall, unless the wall is unusually thick; in peritoneal distention there is a tense, drum-like swelling of the entire abdomen, which is absolutely rigid and tender to the touch. The chief hope of recovery lies in very early recognition of the condition. The cavity is usually opened, the peritoneum irrigated, and drainage established. Turpentine stupes, sprinkled with laudanum, may relieve the rigidity and allay pain.

Many surgeons have an elaborate schedule for the post-

operative nursing of their cases. These are a great help to the nurse, who then knows exactly what she is expected to do at given intervals and in special circumstances. At the same time a very little experience will show the nurse that each patient is a fresh proposition, and that rigidly iron rules may defeat their own object.

There are three complications to be dreaded and guarded against in all operations—*shock*, *hemorrhage*, and *sepsis*.

Shock.—*Early shock* is shown by rapid, small, feeble pulse, pallor, cold extremities, prolonged unconsciousness, profuse sweating, and, usually, subnormal temperature. If the condition is not promptly treated, the life may be lost.

The usual treatment consists in the application of external heat (blankets and hot-water bags), in raising the bottom of the bed so that the head is lower than the feet, in order to flush the vital centers, and in hypodermoclysis of hot normal salt solution (500 c.c.). Enemata of hot normal salt solution, black coffee, or brandy may be ordered, and cardiac stimulants are given by hypodermic injection. Those most commonly ordered are atropin sulphate ($\frac{1}{150}$ to $\frac{1}{100}$ grain), strychnin sulphate ($\frac{1}{30}$ to $\frac{1}{15}$ grain), and oil of camphor (3 to 5 minims).

Later shock is evinced by heightened temperature, restlessness or marked prostration, delirium, and often by prolonged nausea and vomiting. The general treatment consists in maintaining absolute rest and quiet and in nursing up the patient's strength. Usually the bottom of the bed is raised to keep the head low, but in some instances this appears to increase the vomiting, and the orders may be to raise the head of the bed instead. Hypodermoclysis may be ordered daily or twice a day, and stimulants will probably be given. Digitalis is usually preferred (tincture, 5 to 10 minims), as it is a tonic to the heart, and brandy, whisky, or champagne may be ordered. The diet should be as nourishing as the state of the digestion permits. If nausea is persistent, the nourishment is given by rectum. (See also Chap. XVII.)

Hemorrhage.—No nurse should be left alone with an operation case until she is perfectly familiar with the first

symptoms of hemorrhage, since the life depends on the early recognition of the condition.

Hemorrhage is either *external* or *internal*. If the hemorrhage is external, a patch of bright blood may be seen on the dressing, quickly increasing in size. Where the patient is lying on his back, it must be remembered the blood will have a tendency to trickle under the dressing to the lowest point possible, and the bandage on which the patient is lying may be soaked through, while there may be no sign apparent on the dressing immediately over the incision. In abdominal surgery hemorrhage is practically always internal, and the physical symptoms will be the only guide to this very grave condition.

As has already been said, the pulse is the most important indication of a patient's condition after an operation, and *any change is significant*. The first physical symptom of hemorrhage is a steady quickening of the pulse, which also becomes soft and small; accompanying symptoms are pallor, syncope, clammy skin, usually (but not invariably) subnormal temperature, and the condition known as air-hunger, in which the patient fights and gasps for air. Later the patient becomes cyanosed, which is especially apparent round the mouth and under the nails.

Not a moment must be lost in summoning the surgeon. If the bleeding is external, compression of the nearest digital point must be made meanwhile (p. 583). In hospital work the nurse's responsibility extends no further. The treatment consists in placing the patient at once on the operating-table, reopening the incision, and ligating the bleeding spot. The cavity is then usually irrigated with sterile water or normal salt solution in order thoroughly to remove the blood-clots, which, if left in the cavity, would decompose.

If there is any delay, the bottom of the bed is raised, a light ice-bag may be applied over the area, and usually a dose of morphin is given at once ($\frac{1}{4}$ to $\frac{1}{2}$ grain). Stimulants are not given, as by quickening the heart's action they would increase the hemorrhage, and even water must be withheld. Fresh air should be admitted freely.

When the patient is returned to bed, hypodermoclysis of sterile water or normal salt solution is usually given to restore to the circulation the fluid lost, or the fluid may be injected directly into a vein (p. 502). The patient is nursed with the head low until the pulse is normal. After a severe hemorrhage the pulse is markedly subnormal and may be reduced to 40 per minute. Severe thirst is a characteristic symptom, and is usually treated with rectal injection of hot water and washing out the mouth with lemon-juice and water. With external hemorrhage, of course, thirst may be quenched by drinking. (See also Chap. XVII.)

Sepsis.—After a clean operation sepsis occurs only as the result of carelessness. The sources and channels of infection have been pointed out in the chapter on Technic, and it will be remembered that the whole aim and end of surgical technic is the prevention of infection.

The first general symptoms of sepsis are malaise, *shivering*, and a rise of temperature. The importance of shivering as a symptom should be realized. In a few cases it may be due to a nervous condition only, which may or may not be sufficient to upset the temperature. An attack of shivering followed by a rise of temperature is the most characteristic symptom of the invasion of the body by an infection, whether local or general. (Rigors, p. 705.)

Other causes may result in rise of temperature. Thus, a temperature on the day of operation is generally of nervous origin; on the second day it may be caused by a temporary condition, such as constipation or want of rest. The organisms which produce the phenomenon of sepsis take about three days to develop in the human body, therefore a rise of temperature on the third day, especially if preceded by shivering, is always looked on with suspicion. The local symptoms of sepsis are redness and tension in the region of the incision, and the formation of pus.

The treatment varies somewhat with the nature of the operation. Frequently the incision is opened, the cavity cleaned with antiseptics, and drainage established, after which, if the disturbance is local, the temperature may

drop and recovery result without further disturbance. A general septic condition is characterized by fever, either remittent or intermittent, rigors, prostration, rapid emaciation, the formation of secondary abscesses, and a tendency to bed-sores; in many cases it proves fatal.

The treatment is directed locally toward free drainage and the use of antiseptics, and generally toward building up the strength with a nourishing diet and a generous use of stimulants. In extreme cases the patient is best nursed on a water- or air-bed, in order to counteract the tendency to bed-sores.

Sepsis occurring in the second week is usually due to infection from the catgut. On opening the wound a small pocket of pus is discovered; after this is evacuated the symptoms commonly subside. Recovery is, however, delayed, since healing must now take place partly by granulation instead of entirely by first intention.

In common with all wounds, operation wounds may become channels of certain special infections, of which the most important are erysipelas, scarlet fever, and tetanus. (See Chap. XVIII.)

The above dangers are common to all operations. In surgery on special organs special conditions may arise, and in the nursing special details must be observed.

EYE OPERATIONS

An old-fashioned book on nursing opens one of its chapters with the words "no selfish or unconscientious woman should be given charge of a case of tracheotomy." Even more emphatically one might use the words in connection with the nursing of eye cases. Above all other kinds of nursing, success depends on the conscientious attention to small details, and failure may mean the loss to the patient of his most precious possession, since nothing can replace the sight.

Operations on the eye are usually done under a local anesthetic, to avoid the restlessness, nausea, vomiting, and uncontrolled movements following etherization. Frequently the patient remains in his own bed in order to avoid the movements in taking him to and fro. The

preparation (p. 452) must be thoroughly performed, and will for most operations include the dilatation of the pupil with atropin. The head is placed so that the eye on which the operation is to be performed is in the best light. The hair is covered with a sterile towel and the sterile area arranged as in other operations. The requirements, besides the sterile instruments and an eye lens (also sterile), are very simple. A packet of gauze sponges, a couple of eye-pads and a bandage, a douche of warm boric lotion, 2 per cent., and small quantities (about 2 drams) of the special eye-drops, *freshly prepared*, in small sterile bottles with sterile droppers. The bottles contain cocain hydrochlorid the required strength for the local anesthetic (usually 2 per cent.), atropin sulphate (2 to 4 grains to the ounce, mydriatic), and eserin (1 grain to the ounce, myotic).

After the operation both eyes are usually closed and bandaged for at least the first twenty-four hours, and, as a rule, a fixed position is enforced. The room is darkened, special care being taken to prevent streaks of light from an open door or from a badly fitting blind; these are more irritating than a brighter light well diffused.

The dangers of the next twenty-four hours are, first, restless movements which may result in hemorrhage from the recent incision, and, second, that the patient may rub the eyes or put his fingers under the bandage. To rub the eyes if they are irritated is an almost uncontrollable impulse, and a patient may do it unconsciously if not closely watched. Not only is the wound irritated, but there is the greatest risk that it may in this manner become infected and the sight lost.

If the patient is quiet and the pulse steady, all is well. Pain is a symptom that should be at once reported. Usually a surgeon will leave definite orders to be followed if pain arises. Commonly, 1 or 2 drops of atropin are dropped into the eye and compresses of sterile boric lotion (2 per cent.) are applied continuously. These may be hot or ice cold. (See Eye Applications.) The pain may be the result of a hemorrhage or may signify the beginning of inflammation, both of which conditions may be checked

by prompt treatment. Another remedy used in eye surgery for the relief of pain due to inflammation is the application of leeches to the temple (p. 102).

For the first twenty-four hours a nurse will require all her tact, patience, and vigilance. The patient must be fed in the recumbent position and must use the bed-pan. Even in sleep he must be closely watched, since then his movements are least under control. The nurse in charge should not leave the bedside unless some responsible person can take her place. Usually after twenty-four hours the dressing is changed, after which some movement is allowed and the sound eye is unbandaged. The affected eye should look clear, the pupil well dilated. If there is no inflammation the most responsible time of nursing is over, and the patient's own common sense may be to some extent trusted.

Eye surgeons differ in the time necessary to keep the patient lying down or in bed after their operations, and young nurses are inclined to think lightly of strict rules in consequence. This is a mistake. Each step of a treatment is part of a whole; what is not necessary for one process may be essential in another.

If infection takes place the sight will almost inevitably be lost. Leeches are usually ordered and constant compresses, which must be applied without intermission under strict aseptic precautions. The patient's strength is kept up with nourishing diet, commonly some preparation of iron is ordered. If a stimulant is required, strychnin is ordered in preference to the alcoholic stimulants.

TRACHEOTOMY

Another operation case requiring special vigilance in the nursing is tracheotomy. The operation consists of an incision into the windpipe and the insertion of a tube, through which the patient can breathe. It is necessary in conditions where, from false growths, foreign bodies, or injury, breathing is obstructed at a point above the incision. Before the introduction of intubation, tracheotomy was a common treatment in diphtheria, and often

nad to be carried out as an emergency procedure with whatever instruments were at hand.

In performing the operation the throat is exposed by bending the head back over a small sand-bag. When the windpipe is first opened there is a rush of air and blood-

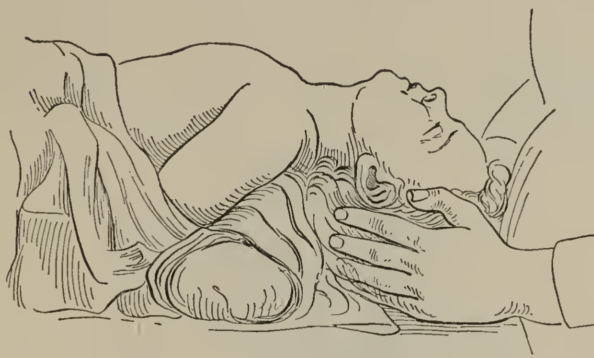


Fig. 173.—Position of patient for laryngotomy and tracheotomy (Morrow).

streaked mucus and a considerable amount of coughing, which is allowed to subside before the tube is inserted. A special dilator is used to hold the incision well open. At first a double silver tube is used, the object being that if the tube becomes blocked with mucus the inner tube

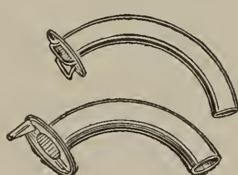


Fig. 174.—Tracheotomy tube (Morrow).

is easily removed and cleaned, whereas if the entire tube is taken out it is often difficult to replace, and asphyxia may result. Later a single tube of either hard or soft rubber is substituted.

The tube is kept in place by narrow tape. The best

method of threading is to thread both ends of a piece a yard long through the holes in the plate; the loop thus formed is passed over the head and the ends are then brought behind and tied in a bow. A small dressing of soft sterile gauze cut to fit round the tube is placed between the plate of the tube and the skin.

The air breathed is taken directly into the lungs without becoming warmed and moistened, as when drawn through the air passages. At first, therefore, the air must be artificially warmed and moistened. To this end the bed is

Fig. 175.—Showing the tracheotomy tube in place (Stoney).

screened and a croup kettle is kept going, with the spout directed into the screened area (p. 332).

Feathers washed in soap and water and sterilized in the autoclave are kept soaking in an alkaline solution, such as bicarbonate of soda, and used to clean the interior of the tube. When a single tube is used this is done with the tube in place, with the double tube the inner tube is removed, cleaned, and replaced.

Constant watchfulness is necessary to prevent the tube becoming blocked, especially where there is much secretion from the lungs or bronchial tubes. If the single tube becomes totally blocked, so that no air can pass and the

patient is in danger of becoming asphyxiated, the tube is entirely removed and the incision held open with the dilator till assistance is obtained.

When the tube is finally removed the patient must also be closely watched until normal breathing is reëstablished. Some patients take a long time to accustom themselves to breathing again in the natural way.

INTUBATION

Intubation has, in the majority of cases, superseded the operation of tracheotomy. This is the introduction of a

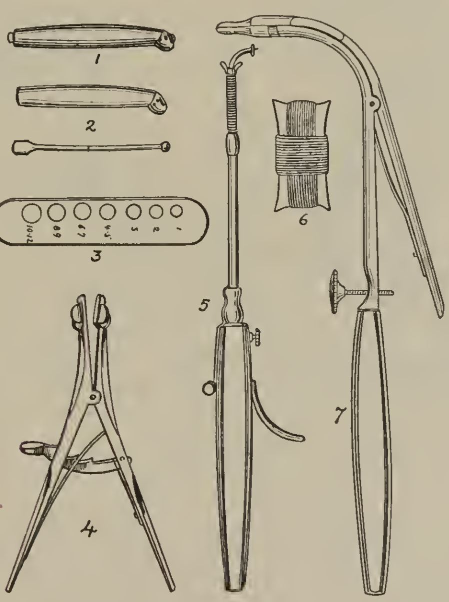


Fig. 176.—O'Dwyer intubation instruments: 1, Tube with obturator in place; 2, tube and obturator separated; 3, gage; 4, mouth-gag; 5, introducer; 6, silk thread; 7, extractor (Morrow).

metal tube made to fit into the larynx and upper part of the trachea, so that the necessary opening is preserved in spite of inflammatory processes or swollen tissues.

The patient is held in an upright position directly opposite the operator, the head bent a little back, the chin in a straight line with the trachea. The mouth is opened and fixed with a gag. The tongue is depressed so as to expose the epiglottis and upper end of the trachea. The tube into which is inserted the obturator is held by an *introducer* and slipped into the larynx, directly in front of the little leaf-shaped epiglottis. When it is in place the introducer and obturator are withdrawn. Where the throat

Fig. 177.—Intubation, introducing the tube into the patient's mouth (Morrow).

is roomy and the tissues are not swollen or inflamed, the process is comparatively easy; where there is much inflammation, with copious discharge and impeded breathing, it is an operation requiring skill and experience. If the tube does not slip into the trachea it may be accidentally deposited in the esophagus, where it will be readily swallowed. To prevent this loss a long strand of silk or stout linen is threaded through a perforation in the tube, by which the tube can be withdrawn if it is not in the right place. This thread may be left in place, the free end being

brought outside the mouth over the patient's ear, and fixed by a piece of adhesive strapping behind the ear. The advantage of this is that should the tube be coughed out of the larynx the thread will prevent its being swallowed. The tube can also be removed by gentle traction on the thread. If there is no thread, a special instrument known as an extractor (Fig. 176, 7) is used to remove the tube.

Every variety of operation brings with it some special details in the nursing, and the difference between an unsuccessful and a good nurse is often just in the care which she gives to these various details. Thus, in operations on the extremities, the joints, or the bones, the physical condition is comparatively unimportant, but the success of the operation may lie entirely in the strict maintenance of a certain position, with the resulting difference between permanent lameness or cure. In operations about the head, especially where the brain has been exposed, as in trephining from any cause, *quiet* is almost the most essential part of the treatment, and the light should always be shaded. In amputation cases there is a certain amount of risk of hemorrhage from the slipping of a ligature, either from abrupt movements or from the reëstablished circulation as reaction sets in. This is especially to be dreaded in amputation of the femur, where bleeding from the femoral artery might be fatal in a short time. In these cases, therefore, we watch the pulse especially closely, and until all danger is past we keep a tourniquet at hand, which can be quickly adjusted. Here again we must remember not to rely on the outward sign of hemorrhage, since from the patient's position the blood will probably run underneath the dressings to the bed before there is any appearance of blood on the top of the dressing.

Only long experience can teach a nurse all she should know of the nursing of operation cases. But at least we should see that the essential details are carefully explained to her and the principal dangers and difficulties pointed out.

CHAPTER XVII

NURSING IN ACCIDENTS AND EMERGENCIES

Shock—Hemorrhage: Varieties; Methods of Arrest—Pressure, Styptics, Ligatures, Torsion; Treatment of Physical Condition; Special Hemorrhages: External, Subcutaneous, Internal, Revealed, Concealed; Enterorrhagia; Hematemesis; Hemoptysis; Epistaxis: From the Throat; From the Ear; Antepartum Hemorrhage; Post-partum Hemorrhage; Hemorrhage from a Ruptured Tube; Hemorrhage in Purpura, Scurvy, Bleeder's Disease; Perforation.

SHOCK

Shock is a profound general prostration or loss of vitality brought about by the effect on the nervous system of severe or violent physical strain, such as an operation or an accident, or, more rarely, by violent mental emotion, particularly fear. Shock follows some one event. When similar symptoms are produced by failing vitality, as during the course of a serious illness, the term *collapse* is used.

The symptoms of shock are pallor; a rapid, feeble pulse, frequently irregular; shallow, sighing, irregular respiration, and subnormal temperature; pinched features, cold extremities, clammy skin, muscular relaxation, and, frequently, syncope. Mental apathy or drowsiness are common, and, in severe cases, total loss of consciousness. On the other hand, the senses may at first be abnormally acute and the mind alert and clear, almost, in fatal cases, to the time of death. Nausea and vomiting may be present and are usually considered favorable symptoms, showing a return of vitality to the nerve-centers.

The condition of shock or collapse is probably the most common emergency in nursing, and as the successful treatment depends upon early recognition of the symptoms, the observation must be trained to detect the signs promptly.

Treatment is directed toward restoring the vitality of the nerve-centers and to the relief of the physical condition.

It will be remembered that the important nerve-centers, such, for example, as those controlling the action of the heart or governing the movements of respiration, are contained in the medulla oblongata, the expanded end of the spinal cord which is situated at the base of the brain. By placing the patient in the recumbent position, with the head low, a further supply of blood is directed to the nerve-centers. The pillows should be removed and the bottom of the bed elevated. The loss of heat to the body is conteracted by the application of external heat, hot blankets, hot-water cans or bags, and friction of the extremities under cover. Fresh air is a *necessity* for the failing respiration, though its importance is sometimes overlooked. If not freely procurable, oxygen may be ordered. To stimulate the circulation either sterile water or normal salt solution (500 c.c. at a temperature of 115° to 120° F.) may be given by hypodermoclysis, by enteroclysis, or by intravenous infusion.

Stimulants are usually given unless hemorrhage is also present, or in cases of injury to the head. Atropin, the most powerful respiratory and cardiac stimulant known, strychnin, ether, or camphor, are generally given by hypodermic to insure prompt action. Whisky, brandy, strong hot coffee, or tea may be given by mouth, or, if the patient is unconscious, by enema. If the abdomen or pelvis is injured or hemorrhage is present, nothing should be given by mouth without special orders.

The electric battery, a mustard plaster over the heart, the hot mustard foot-bath, are means also employed for the purpose of indirect stimulation of the nerve-centers.

After an accident the symptoms of shock may be marked by temporary excitement and develop after the lapse of some hours. Both in slight and severe accidents the probability of shock should be borne in mind. This is especially so in cases of burns and scalds, and particularly in children. The worst effects may often be averted by

prompt preliminary treatment of rest in the recumbent position, quiet, and the application of external heat. Close watch must be kept on the pulse, a rapid, feeble pulse being usually the earliest indication of the condition of shock.

The after-effects of severe shock are a raised temperature due to reaction, lightheadedness, and sometimes delirium; the physical prostration may last some time. In alcoholic patients delirium tremens is apt to develop and is first evinced by inability to sleep.

The treatment is rest in bed, enforced quiet, and a light nourishing diet until the normal condition is attained. If there is excitement or wakefulness, sedatives or narcotics are generally ordered. If a stimulant is given it is usually digitalis, which is a tonic to the heart.

HEMORRHAGE

By hemorrhage is understood an escape of blood from a blood-vessel. A severe loss of blood to the system may prove rapidly fatal, and is always a serious drain on the vitality. It is, therefore, imperative that the presence of hemorrhage should be immediately recognized in order that it may be promptly controlled.

Hemorrhage may occur from rupture of an artery, a vein, or a capillary.

Bleeding from an artery is bright red in color and occurs in jets or spurts, corresponding to the beating of the pulse. If a large artery is injured, hemorrhage may prove fatal in a few minutes.

In bleeding from a vein the blood is dark in color and the flow steady, slow, and uninterrupted. The reason for the difference of color is that by the time the blood has reached the veins it has parted with its oxygen, to which it owes its bright red color, and taken up carbonic acid gas, a product of combustion. After venous blood has been exposed to the fresh air it again becomes oxidized and bright red. The veins have not the elastic resistance of the arteries, therefore the stream flows without interruption.

Bleeding from the capillaries occurs as a general oozing. Over a large surface capillary bleeding may mean a considerable loss, and is often difficult to control.

Varieties.—Hemorrhage is said to be *traumatic* when it is the result of a wound; *spontaneous*, when it occurs without previous injury to the tissues. Traumatic hemorrhage is *primary* when it occurs at the time the wound is inflicted; *secondary*, if it occurs at a later period, in some instances hours, in others days, *after the time of injury.*

The most common causes of secondary hemorrhage are the slipping of a ligature, usually occurring within the first twenty-four hours, and the separation of sloughs, occurring after the lapse of several days. It may also result from the quickening of the circulation due to a return of vitality after conditions of severe shock, in small unligatured vessels.

Hemorrhage may be *external*, *subcutaneous*, or *internal.* Internal hemorrhage may be *revealed* or *concealed.*

In *revealed* hemorrhage the blood escapes by the orifice nearest to the bleeding point, such as the mouth or nose, the rectum or vagina. In *concealed* hemorrhage the blood cannot escape and the condition is entirely diagnosed by the physical symptoms, the effect, that is, of the loss of blood on the system.

Physical Symptoms of Hemorrhage.—The first and most important of these symptoms is a *sudden change in the pulse*, which becomes *rapid*, *soft*, and *frequently irregular*, at the same time there are usually pallor and faintness. If the hemorrhage is not quickly checked, further symptoms rapidly develop. The most prominent are shallow and irregular respirations, accompanied by sighing, yawning, and later the condition of air-hunger already described, in which the patient gasps and fights for breath; cyanosis or blueness of the skin and mucous membranes, noticeable first around the lips and later under the nails of the fingers and toes; restlessness, anxiety, and profound exhaustion. Fainting or syncope is a favorable condition, the feeble action of the heart causing the blood to flow less forcibly. Unless the syncope threatens to

become collapse no treatment is given for the relief of this condition until the hemorrhage is arrested, other than placing the patient in the recumbent condition.

TREATMENT OF HEMORRHAGE

The primary treatment of all hemorrhages is the arrest of the hemorrhage; second to this (unless the patient is in extremis) comes the treatment of the physical condition.

To a certain extent the quantity of blood lost may be controlled by position. In the recumbent position the heart acts less forcibly, consequently the flow of blood from the divided vessel is also less forcible. The supply of blood to a part is also considerably lessened if the part is elevated. The first treatment in hemorrhage is to make the patient lie down flat and elevate the injured part. The head must be kept low (as in *shock*), the pillows removed, and, as a rule, the bottom of the bed elevated.

If the bleeding is from an extremity, the limb is easily elevated by suspension or on pillows. The supply of blood is further lessened if at the same time the joint above the bleeding point is acutely flexed. In hemorrhage from the lower part of the trunk the elevation of the foot of the bed will also elevate the injured part. In hemorrhage from the head or upper part of the trunk it is best to keep the patient quite flat unless special orders are given to raise the head of the bed, in which case the pulse must be very closely watched, in case fatal syncope should result.

Hemorrhage is arrested by closing the blood-vessel, either by the formation of a clot, by causing contraction of the walls of the vessel, or by mechanical means. The methods used are as follows:

Exposure of the bleeding point to the air.

Pressure, either direct or indirect.

The application of heat or cold.

The direct application of astringents or styptics.

The indirect action of styptics administered by mouth or hypodermically.

Mechanical closing of the ruptured vessel either by ligation or by torsion.

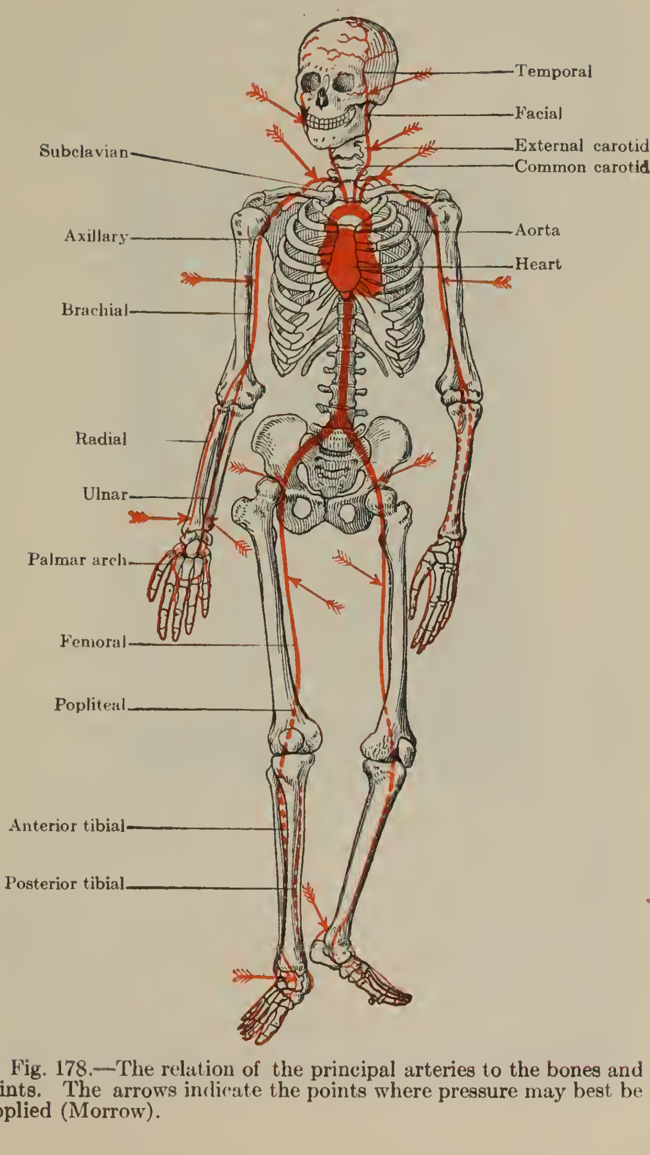


Fig. 178.—The relation of the principal arteries to the bones and joints. The arrows indicate the points where pressure may best be applied (Morrow).

Exposure to the Air.—Blood on exposure to the air naturally clots. In mild cases *exposure* of the bleeding point to the air may be sufficient to arrest the hemorrhage, the part at the same time being elevated and the patient in the recumbent position. When the bleeding is controlled, a sterile dressing should be firmly applied.

Pressure.—Direct pressure is usually applied by means of pads or packing of sterile gauze.

Whatever the haste, it must not be forgotten that the bleeding surface may easily be infected, and should come in contact with nothing that is not surgically clean.

Fig. 179.—Digital compression of brachial artery (Marwedel).

If the wound is deep, it is lightly packed with narrow strips of sterile gauze or a narrow bandage, over which a pad is applied with a firm bandage. Where the wound is in a hollow, such as the palm of the hand, the axilla, etc., several pads are applied, the first small enough to fit the wound, and each succeeding layer a littler larger, forming a graduated compress.

In hemorrhage from an orifice, such as the vagina, pressure may be applied to the bleeding point by packing the entire cavity tightly with gauze. (See Chap. VI.) Pads or packing applied for the purpose of arresting hemorrhage must be closely and repeatedly examined to ascertain whether blood is not soaking through the dressing. At the same time it should be remembered that where

a wound is hidden by thick dressings, a revealed hemorrhage may be thus converted into a concealed hemorrhage, of which the only evidences are the physical symptoms of hemorrhage. The pulse, therefore, and the color of the patient must be closely watched, in order that the

Fig. 180.—Forced flexion of the elbow (Morrow).

first symptoms of a recurrence may be promptly noticed. In removing dressings for pressure, it will be found that the blood has caused them to adhere closely to the injured site. To pull on the dressing may reopen the bleeding point. They should be soaked with cold[1] sterile water until they come away without force. The dressing

[1] Warm water, by relaxing the parts, may again start the bleeding.

is removed usually after twenty-four hours. In some cases the outer dressing only is removed and that next the wound left for another twenty-four hours.

Direct pressure is used in mild hemorrhages and in cases where the bleeding vessel is not sufficiently exposed to be easily ligated. (*Hemorrhage from the Nares,* see below.)

Fig. 181.—Compression of the radial and ulnar arteries at the wrist (Morrow).

Indirect pressure is used as a *temporary* means of arresting external hemorrhage, especially in injuries to an extremity. The pressure is applied at a point along the course of the main vessel, supplying the part, and either above or below the bleeding spot, according to whether the injury is to an artery or to a vein. Injury to a main artery is a very serious condition, cutting off the main

supply of blood to the part, and may be followed by gangrene. Owing to their protected position deep in the

Fig. 182.—Compression of the subclavian artery (Morrow).

Fig. 183.—Forced flexion of the knee (Morrow).

tissues, the main arteries are less frequently injured than the smaller and more superficial vessels. The blood in

an artery flows from the heart toward the extremities; indirect pressure is, therefore, applied between the bleed-

Fig 184.—Digital compression of femoral artery (Marwedel).

Fig. 185.—Compression of the temporal artery (Morrow).

ing point and the heart; in a vein the blood is flowing toward the heart, and indirect pressure is, therefore, applied

below the bleeding point, that is, with the bleeding point between the heart and the point of pressure.

The methods commonly used to apply *indirect* pressure are *digital pressure* and the application of a *tourniquet.*

In **digital pressure** the main blood-vessel is compressed between the fingers and the bone, over the outer surface of which the vessel passes. In order to apply digital pressure the course of the principal blood-vessels must be known, and the points at which they can best be reached (the

Fig. 186.—Compression of the facial artery (Morrow).

digital point). This should be taught by the use of anatomical charts and by demonstrations in class. When pressure sufficient to control a hemorrhage is made on an artery, the pulse below the point of pressure is obliterated.

It is difficult, without experience, to make digital pressure sufficiently firm to control hemorrhage. The application of a tourniquet, where practical, is, therefore, commonly the more reliable method.

The principal digital points for the different arteries are as follows:

Site of Hemorrhage.	Vessel.	Digital Point.
The forearm or hand.	Brachial artery.	Inner surface of the arm (upper), between the two large muscles, against the humerus, at a point about one-third the distance from the axilla to the elbow. The elbow should, at the same time, be forcibly flexed and a pad inserted in the bend.
The hand.	Ulna and radial arteries.	Preferably, as above, also at the wrist. Against the radius, on the inner surface, at the thumb side, and against the ulna on the inner surface on the side of the little finger; the elbow is flexed and the hand elevated.
The axilla or shoulder.	Subclavian artery.	Against the clavicle from behind, about midway between the point of the shoulder and the sternum.
The leg and foot.	Poplitealartery.	Behind the knee, against the femur. Best applied by placing a pad behind the knee (the popliteal space) and acutely flexing the knee. The thigh must also be flexed in order to keep the part elevated.
The thigh.	Femoral artery.	Against the rim of the pelvis in the groin, at the point where the femoral pulse is felt, *i. e.*, about two-thirds the distance from the hip to the middle line of the body. The whole extremity should be elevated, the thigh slightly flexed.
The scalp.	Temporal artery.	Against the zygoma where the pulse can be felt, directly in front of the ear, opposite the external opening of the auditory canal.
The face.	Facial artery.	Against the lower jaw bone, where the pulse can be felt, at a point below the angle of the mouth, at the anterior edge of the masseter.

A *tourniquet* is made of a piece of thick, strong elastic rubber, flat or round, sufficiently long to pass two or three times round a limb, and provided with some mechanism by which it can be securely clamped and held without slipping. Fastened tightly round a limb, it will effectually stop the circulation and, therefore, arrest hemorrhage. It should not be left on more than an hour, or gangrene of the part may result. In applying the tourniquet, the

part should first be protected by a piece of lint, or several folds of gauze, etc., in order to prevent pinching and bruising of the skin. If it can be applied at the digital point, a small hard pad should be inserted under the tourniquet, over the exact point of digital pressure. A roller bandage makes a serviceable pad.

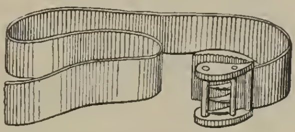


Fig. 187.—The field tourniquet (Morrow).

A tourniquet may be improvised with a handkerchief or a piece of bandage. It should be passed twice round the limb, and knotted with a double knot over the digital point, a hard pad being inserted under the bandage below the knot. Through the knot a piece of wood or a pair of scissors, etc., is slipped and twisted tightly round and

Fig. 188.—The application of the field tourniquet (Morrow).

round, thus tightening the tourniquet and pressing the pad against the artery.

In applying indirect pressure to a vein the bleeding point itself must first be covered by a sterile pad, in order to exclude air from the empty vessel. In the case of injury

to a large vein, for the same reason, pressure is applied above as well as below the lesion. As a rule, venous hemorrhage is best controlled by *direct* pressure at the bleeding point.

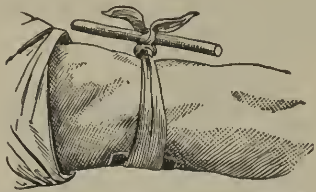


Fig. 189.—Improvised tourniquet (Stoney).

Acupressure.—An old-fashioned means of applying indirect pressure is known as *acupressure*. A needle is passed through the tissue behind an artery. A piece of

Fig. 190.—Showing so-called Spanish windlass, an improvised tourniquet, compressing the brachial artery (de Nancrede).

silk is then wound tightly round the needle, in a figure-of-8 in front of the artery, thus causing compression. The needle is removed in from six to eight hours. At

the present day acupressure is rarely used. It is considered chiefly of value for such parts where a tourniquet is impractical, as in hemorrhage from the scalp or in the treatment of ruptured varicose veins.

Indirect pressure is never more than a temporary treatment. For the actual arrest of hemorrhage it is necessary that the ruptured vessel should be sealed, either by the formation of a clot, by inducing the walls of the vessel to contract, or by mechanically closing the vessel.

Heat and Cold.—Heat may be applied to a bleeding point in the form of a douche or irrigation of very hot sterile water (114° to 120° F.), or by the application of the *actual cautery*. The application of heat both induces

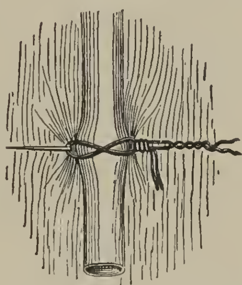


Fig. 191.—Method of employing acupressure by means of a threaded needle passed behind and a figure-of-8 wire passed in front of vessel (de Nancrede).

the contraction of the arterial walls, and causes the blood to clot by coagulating the albumin; it is, therefore, a valuable agent. Hot irrigation of sterile water is a common means of arresting hemorrhage from vessels in extensive operations or in troublesome capillary oozing. The water used must, however, be not less than the above temperature. Water merely warm encourages hemorrhage by causing relaxation of the arteries. Care must be taken to prevent the skin from being scalded, the mucous membranes and the internal tissues bearing readily a moist heat that will injure the skin.

The actual cautery (see Chap. III) is frequently used at operations to control a general oozing over a more or

less extensive surface. Its chief use is in rectal operations. If not used with caution, it may cause extensive sloughing.

Cold arrests hemorrhage by causing contraction of the vessels. It is applied in the form of ice, ice suppositories, ice compresses and ice-bags, or irrigations of ice water.

Cold water dissolves albumin, and thus delays the coagulation of the blood, though it favors contraction and constriction of the arteries. It is, on the whole, a less valuable agent for the purpose than hot water. It can, however, be used in many cases where the application of hot water of the necessary temperature is not practical, as, for example, in hemorrhage from a throat, where there is risk of scalding of the adjacent tissues, which would be a dangerous complication.

Astringents and Styptics.—An astringent is a drug that produces contraction of the tissues and reduces secretions; many of them, such as the acid astringents, also coagulate the albumin of the blood, thus forming a clot. Properly speaking, heat and cold are also astringents. The most commonly used astringent in treating hemorrhage is acetic acid, or vinegar. It is generally given in conjunction with the hot douche—acetic acid, ½ ounce, to water, 1 pint (vinegar, 1 ounce to 1 pint). Powerful astringents are called *styptics*, or, from the fact that they check hemorrhage, *hemostatics*. The most commonly used are: Adrenalin chlorid (solution, 1 : 10,000 to 1 : 25,000); tannic acid (powder, or saturated solution in glycerin); alum (saturated solution); iron (either tinctura ferri chloridi, or Monsell's solution); nitrate of silver (solution, 4 to 10 per cent., or stick). They are applied directly to the bleeding point, either by an applicator or in the form of a spray (nose and throat).

The metal astringents, while effectually checking hemorrhage, cause later sloughing of the tissues, with the risk of further hemorrhage; their use, therefore, is limited. When available, either adrenalin or tannic acid is preferred. Preparations containing tannic acid, such as witch-hazel, are excellent as domestic remedies. *Styptic collodion*, a preparation of collodion and tannic acid (20 per cent.), and *styptic cotton*, an absorbent cotton charged with iron

sulphate, are occasionally used in the dressing of wounds complicated by troublesome hemorrhage.

A hemorrhage may also be controlled indirectly by the administration of hemostatics internally, either by hypodermic injection or by the mouth or rectum. Taken into the system, their action is to cause constriction of the smaller blood-vessels. Those most frequently used are: Adrenalin chlorid (mouth, 10 to 30 minims; hypodermically, diluted ten times with normal salt solution), ergot (mouth, fluidextract, 30 minims to 1 dram: hypodermically, ergotin, 2 to 5 grains), and gallic acid (pill form, 10 to 30 grains). Ergot, besides causing constriction of the blood-vessels, acts directly on the muscular tissue of the uterus, causing powerful contractions; it is, therefore, of great service in the treatment of postpartum hemorrhage.

In conditions that favor hemorrhages, such as the existence of sloughing ulcers (as in typhoid fever), in the treatment of aneurysm, and of those diseases complicated by spontaneous hemorrhages (see below), substances that favor the clotting of blood are frequently administered regularly over a length of time. The principal are calcium chlorid (10 grains) and gelatin. The latter is generally given in the diet in the form of jellies, but may also be administered by rectum. In the latter case it must be diluted until sufficiently thin to flow through the enema tube. More rarely it is given by hypodermic injection, diluted to a 2 per cent. solution in sterile water.

Ligature.—The mechanical method of arresting hemorrhage is by ligating the bleeding vessel. The vessel is seized by a pair of forceps, slightly stretched, and the ligature tied round it in a firm surgical knot. Unless securely tied (p. 290), the ligature may slip, causing a secondary hemorrhage. Ligatures are usually of catgut, which can be absorbed into the tissues. Ligation of the vessels is the usual method of arresting hemorrhage caused by an operation.

Torsion, or twisting of an artery, is a means of contraction chiefly used for the smaller vessels. If an artery is cut clean across, the walls do not contract. If, however, the walls are torn or divided unequally, the elastic fibers

in the walls of the artery tend to curl up on themselves, thus contracting and closing the vessel, and forming, at the same time, an irregular surface on which fibrin is readily deposited. In torsion the artery is seized in a pair of forceps, stretched, and twisted. The walls are broken and contraction induced.

Treatment of the Physical Condition.—Ordinarily, until the hemorrhage is arrested, the treatment of the physical condition is confined to placing the patient in the recumbent position, usually with the head low and the feet elevated, for the reasons given above, at the same time preventing any movement that may exhaust him and cause further loss of blood; always remember he should have *plenty* of fresh air. No stimulants should be given:

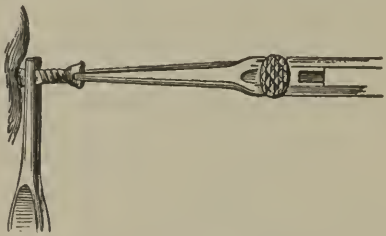


Fig. 192.—Method of controlling hemorrhage by torsion (Da Costa).

they tend to increase hemorrhage. If a drink cannot be denied, it should be cold water. Faintness need not be relieved unless it tends to pass into fatal syncope. External warmth, by restoring the vitality, also favors hemorrhage. The general condition of the patient and the promptness with which surgical help can be obtained must frequently determine how far the physical condition can be relieved before the hemorrhage is checked.

When the hemorrhage is arrested, treatment is directed toward restoring the vitality. The condition is one of extreme shock, and the treatment is on the same lines. The patient is kept in the recumbent position, with the feet well elevated. After severe hemorrhage, or if there is danger of recurrence, the position is maintained until a normal condition is reëstablished, when the bed should

be lowered gradually—not more than half a foot a day. External heat is applied in the form of hot blankets, hot-water cans, and friction of the extremities under cover. Large poultices are sometimes ordered to the calves of the legs and over the abdomen; in the collapsed condition of the patient they are, however, likely to cause burns, unless closely watched and removed on the first sign of reddening. Hypodermoclysis or intravenous infusions of normal salt solution (500 c.c.), or enemata of hot normal salt solution (200 to 500 c.c.), are generally given for the purpose of restoring fluid to the circulation.

Intense thirst is a prominent after-effect of hemorrhage. Where practical, water, tea, etc., are given freely by mouth; in other conditions the thirst is best combated by sips of boiling hot water. Stimulants may be ordered, but are given with caution on account of the risk of a recurrence of the hemorrhage. For the immediate results, atropin, strychnin, or alcohol is generally ordered; in the after-treatment digitalis is preferred, as it acts as a tonic to the heart. Morphin ($\frac{1}{12}$ to $\frac{1}{4}$ grain) is frequently ordered, especially in hemorrhages connected with the alimentary tract. It reduces the general restlessness and, by checking peristalsis, restrains local movement.

Where the loss of blood has been severe, *auto-infusion* may be practised in order to keep as much blood as possible circulating in the vital organs. The extremities are elevated and firmly bandaged from the tips of the fingers or toes toward the trunk. Usually one of the four limbs is left unbandaged, and every ten minutes the bandages from one limb are changed to the unbandaged limb. In this way no limb is bandaged for longer than half an hour at a time.

The immediate after-effects of hemorrhage are exhaustion, intense thirst, and anemia. The pulse is slow—in severe cases frequently lower than 45. Later there may be fever, with lightheadedness or delirium. The treatment is the same described for delayed shock. Hypodermoclysis of normal salt solution is frequently ordered at repeated intervals. Hot water and hot drinks, such as tea, relieve the thirst more efficiently than cold drinks or

ice. The anemia is treated with prolonged rest, fresh air, a nourishing diet, and usually iron in some form is ordered (Blaud's pills, or tinctura ferri chloridi, etc.). It is often a very persistent symptom, and is an undesirable complication, especially after an operation, prolonging convalescence and delaying recovery.

SPECIAL FORMS OF HEMORRHAGE

External hemorrhage is hemorrhage occurring on the surface of the body, and is almost invariably the result of violence. It is the most simple form of hemorrhage to treat, being quickly recognized, and the local treatment generally easy to apply. Care must be exercised to keep the wound sterile. Arterial external bleeding may be controlled by any of the methods described above.

If the hemorrhage is venous, the best method of controlling it is usually direct local pressure with a graduated pad, the part being well elevated. The commonest form of venous bleeding is a ruptured varicose vein in the leg. After the pad is applied, the whole limb is enveloped in a rubber bandage, beginning at the toes and bandaging upward. In obstinate cases, where bleeding tends to recur, an operation may be necessary, and the vein is ligated. For these cases also *acupressure* is still occasionally performed. In external capillary bleeding exposure to the air may be sufficient to check the oozing. If not, direct pressure or the application of heat, cold, or an astringent is next tried. A powerful styptic, such as iron, will always stop hemorrhage, but where the physical symptoms are not urgent, other methods should be tried first, on account of the tendency of strong styptics to cause sloughing.

Subcutaneous hemorrhage is an extravasation of blood into the tissues. It may be the result of injury (traumatic) or disease (spontaneous). The appearance of traumatic subcutaneous hemorrhage is familiarly recognized as bruising. The bleeding is diffused over a more or less extensive area, producing a discoloration of the tissue, at first purple, then fading as absorption takes place into

green and yellow. Such an extravasation of blood is called *ecchymosis*.

The treatment consists in the application of cold, usually in the form of a compress, unless the injury is extensive, when the lessening of the blood-supply to the part increases the danger of sloughing. Hot applications, which dilate the vessels, thereby increasing the blood-supply and restoring the vitality of the part, are then preferred. The cold application may with advantage be combined with an astringent, such as arnica or witch-hazel, which aids in checking exudation. They are best applied in the form of compresses.

Some diseases are characterized by minute extravasations of blood under the skin, giving the appearance of a rash of small purplish spots known as *petechiæ*. A petechial hemorrhagic rash is common in purpura, scurvy, and typhus fever. It is also met with in malignant forms of smallpox and measles, and may also less frequently be met in other conditions. Small localized subcutaneous hemorrhages are common in arteriosclerosis, a condition in which the arteries become hard and inelastic and are easily ruptured. Extravasation of blood under the conjunctiva has a bright-red appearance, owing to the constant exposure of the clot to oxygen through the thin membrane of the conjunctiva, and often causes unnecessary alarm. For these small extravasations no treatment is necessary. They gradually become absorbed and disappear.

Internal hemorrhage is always a grave condition. It may be serious from the amount of blood lost, or, where the blood cannot escape, from the effects of the hemorrhage on the adjacent structures. For example, a small hemorrhage in the brain may, from the pressure caused by the clot, give rise to a fatal apoplexy; a slight hemorrhage into the lung may cause septic pneumonia; bleeding into the peritoneal cavity, though not extensive, will shortly set up septic peritonitis from decomposition of the blood.

As has been said above, internal hemorrhage may be *revealed* or *concealed*. In revealed hemorrhage we have

the evidence of an escape of blood, either from the orifice of the body nearest to the injured structure or from a wound. The bleeding point may frequently be reached and local treatment applied.

In *concealed hemorrhage* the condition is only demonstrated by the physical symptoms already described. It is, therefore, the graver condition, being more liable to be overlooked.

The common causes of internal hemorrhage are as follows: After an internal operation, from imperfect closing of a vessel, the slipping of a ligature, or the separation of sloughs: from an accident causing injury to an internal organ, for example, fracture of the pelvis or the skull; sloughing of an ulcer causing perforation of a blood-vessel at some point in the alimentary tract: rupture of the tube in a case of Fallopian gestation: separation of a portion of the placenta previous to labor; relaxation of the uterus after labor: injury or disease of one of the kidneys: spontaneous hemorrhage, usually from the mucous membrane of some portion of the alimentary tract.

The symptoms accompanying internal hemorrhage are greatly modified by the function and position of the organ affected. The characteristic symptoms and the special treatment necessary must, therefore, be considered in detail.

Hemorrhage from the Bowels (Enterorrhagia).—The common cause of enterorrhagia is rupture of a vessel from the perforation of an ulcer, usually due to separation of a slough, in the walls of the intestine, as in typhoid fever. It is sometimes directly caused by acute distention of the walls of the intestines before the ulcers have healed; enterorrhagia may also occur spontaneously in purpura or scurvy. It is always a grave condition, and frequently fatal to life, especially when the patient's strength is reduced by prolonged illness, as in typhoid fever.

A discharge of blood and mucus from the rectum is a common symptom in inflammatory conditions of the alimentary tract, as in enterocolitis, or in poisoning by corrosives or irritants. It is not dangerous to life in the same sense. Hemorrhage from internal hemorrhoids oc-

curs usually at the time of defecation, and is bright red and passed on the top of a stool.

The symptoms of enterorrhagia are those of internal hemorrhage in a marked degree, as already described; usually there is a sudden fall in temperature and a sharp rise in the pulse-rate; distention is frequently present; sooner or later there is a discharge of blood from the rectum. If the bleeding point is low, the blood may be bright red in color and either gush from the anus or be passed in clots. If the point is high in the bowel, the blood is "altered" by the digestive juices, and appears as a dark-brown or black, viscid fluid, mixed with fecal matter. Some hours after the hemorrhage has occurred the stools are black in color and sticky; they are known as *tarry stools* (p. 227).

The treatment consists in absolute rest on the back, with the bottom of the bed elevated higher than the shoulders, and the pillows removed. An ice-bag or Leiter's coils are applied to the abdomen, especially to the right side, which is the site of the glands usually first attacked in typhoid fever. All other treatment is stopped. No nourishment or water by mouth is allowed for at least twenty-four hours. No movement of the pelvis must be permitted; the stools are received on pads of tow. The skin of the coccyx may be protected by a ring air-cushion *slightly* inflated. The room is kept at a low temperature (55° to 60° F.); the bed-clothes should be light and prevented by a bed-cradle from weighing on the abdomen.

No stimulants are given. If exhaustion is severe, hypodermoclysis of water or normal salt solution is usually given. Morphin is generally ordered ($\frac{1}{12}$ to $\frac{1}{4}$ grain), and the patient kept under the influence of the drug until the danger is past. Hemostatics, such as ergot, may be ordered and are generally given by hypodermic. If the hemorrhage tends to recur, a course of calcium chlorid (10 grains) or gelatin is frequently ordered by mouth or rectum. Close watch must be kept for symptoms of *perforation* (p. 610). Treatment by mouth is renewed with caution, generally beginning with sips of hot water after twenty-four hours to two days have elapsed. Three days from an attack the patient is usually allowed to be turned, using no effort

himself, after which the bed is gradually lowered and normal conditions cautiously resumed.

Hemorrhage from the bowel arising from hemorrhoids is not so serious a condition; the loss is usually not sufficient to cause acute physical symptoms. Rest for a short time in bed, the introduction of ice suppositories or of a suppository containing an astringent, usually gall or tannic acid, is generally all the treatment required. If there is severe pain, opium or cocain is frequently combined with the astringent. The feces are kept soft by mild laxatives.

Hemorrhage Due to Purpura, etc.—(See Spontaneous Hemorrhage.)

Hemorrhage from the Stomach (Hematemesis).—The usual cause of hematemesis is perforating gastric ulcer; it also occurs spontaneously in purpura or scurvy.

The first symptom is frequently the vomiting of darkish blood mixed with mucus and food-particles. (See Chap. VII.) If the bleeding is slight and the blood has remained any length of time in the stomach, it is altered by the digestive juices and has the appearance of coffee-grounds. Later, the stools are tarry from the presence of blood which has passed into the intestines. The physical symptoms are mild or grave according to the loss of blood and the frequency with which the hemorrhages recur.

The treatment is the same as in hemorrhage from the bowels. When treatment by mouth can be resumed, gelatin is frequently ordered as part of the diet. In severe cases, where attacks of hemorrhage recur, an operation is frequently performed by which the ulcer is excised and the wall of the stomach repaired.

Hemorrhage from the Lungs (Hemoptysis).—Hemoptysis may result from: (1) The breaking-down of a cavity involving the wall of a blood-vessel in pulmonary tuberculosis; (2) the rupture of an aneurysm; (3) the result of venous congestion in heart disease; (4) injury, as in perforation of the lung by a fractured rib or a gunshot wound.

In the first condition the first sign is usually, but not invariably, a preliminary cough, followed by the taste of a warm, salty fluid in the mouth, which proves to be

blood. The quantity lost at a time is usually slight. The blood is bright red and frothy, from being mixed with air-bubbles. If a large vessel is ruptured, the quantity may be sufficiently great to flood the respiratory passage, and death results from asphyxia.

The usual immediate treatment is rest in bed, generally with the shoulders elevated, and plenty of fresh air. The patient should be out-of-doors or by an open window. If he is in a room, the temperature should usually be as low as can be obtained. Movement is limited, but not entirely prohibited. An ice-bag is sometimes applied over the affected part, but more often is found to increase the tendency to cough. Morphin ($\frac{1}{12}$ to $\frac{1}{4}$ grain) is generally ordered, as it helps to reduce the cough and quiet the patient. Hemostatics are not much given, nor are astringent inhalations usually considered of value. Ice to suck takes away the taste of blood and diverts the patient's mind. No stimulants are given. The diet is kept low (milk and eggs) for a day or two. Movement and exercise are resumed with caution—usually not before twenty-four hours have elapsed. If the hemorrhages tend to recur, gelatin is frequently given in the diet.

Hemoptysis, caused by venous congestion, is coughed up a little at a time and mixed with expectoration. A considerable quantity may be lost in twenty-four hours. It is not an emergency, but one of the symptoms of a disease, and treatment is influenced by the underlying cause.

Rupture of an aneurysm into the lung causes death in a few minutes from the flooding of the lungs and respiratory passages with blood, as well as from syncope from the loss of blood. Bright red blood pours from the mouth and nose and no treatment is possible.

Hemoptysis caused by injury is grave or mild, according to the extent of the injury. In mild cases the treatment consists in absolute rest, repair of the injury, and the local application of an ice-bag. When an injury is severe, as in perforation of the lung by a gunshot, it is generally fatal.

Hemorrhage from the Nose (Epistaxis).—The most common cause of nosebleed is a slight violence to a weak-walled vessel in the nose, as in blowing the nose with too

much force; it may also occur after an operation on the nares or tonsils, or spontaneously in the course of *scurvy* or *purpura*.

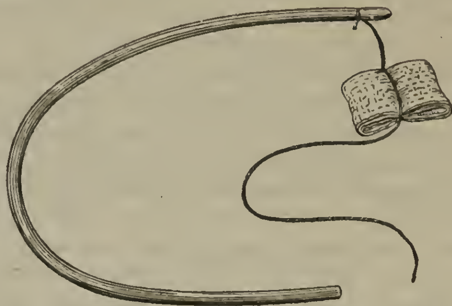


Fig. 193.—Catheter for drawing plug into the posterior nares (Morrow).

Fig. 194.—Showing the method of drawing a plug into the posterior nares by the aid of Bellocq's cannula (Morrow).

For a mild attack the patient is laid flat on the back, and cold, usually in the form of compresses, applied to the

nape of the neck and over the nose. In severe cases the nares may be sprayed with an astringent or mild styptic (vinegar and water, 1 ounce to 1 pint, or adrenalin chlorid, 1 : 10,000 to 1 : 5000), or plugged with strips of sterile gauze. The hemorrhage is usually from the anterior nares.

Bleeding after an operation on the posterior nares is often difficult to control. Ice to suck, cold applications over the nose and to the nape of the neck, are the usual remedies first tried. Styptics may be applied to the spot,

Fig. 195.—The posterior nasal plug in place (Morrow).

if it can be reached, or used in the form of spray. Those most used are adrenalin chlorid (1 : 10,000 to 1 : 5000), tannic acid (20 to 50 per cent.), or persulphate of iron. In some cases it is necessary to plug the posterior nares. A plug of sterile gauze or cotton is introduced in the following way:

A fine soft-rubber catheter is threaded with a double piece of stout linen thread. The catheter is passed through the nostril and by the pharynx, into the mouth. To pass the catheter push the tip of the nose upward and direct

the catheter straight backward into the passage exposed. The threads are seized and tied securely around the plug, leaving an end about six inches long free. The catheter is then withdrawn, carrying the one end of the thread with it; the plug is guided into the posterior nares by a finger inserted into the mouth, and pulled firmly into place by the string through the nostril. The anterior nares are then packed with gauze. At the end of twenty-four hours the packing is removed and the nose gently douched to soften the plug and prevent it adhering. Traction is then made on the string in the mouth and the plug removed.

Bleeding may continue after the plug is inserted, and be concealed by the application. Any change in the pulse, and such symptoms as pallor and yawning, must be promptly reported.

Bleeding from the throat may result from severe sloughing, as in cases of *scarlatina anginosa*, or follow excision of the tonsils. The blood may escape by the mouth or nose. If much is swallowed, it is usually vomited. Enough may be swallowed to give the stools a tarry appearance. The treatment consists in giving ice to suck, ice-cold or astringent sprays, or the direct application of styptics, adrenalin chlorid, tannic acid, or iron.

Bleeding from the ear is most commonly associated with fracture of the base of the skull (p. 626).

Post-operative Hemorrhage.—(See p. 567).

Hemorrhage Connected with Childbirth.—Hemorrhage occurring during pregnancy or during labor, before the actual birth, is known as *antepartum hemorrhage.*

The cause is the separation of the small portion of the placenta, usually the result of an accident, such as a fall; during labor it is commonly due to malposition of the placenta. The hemorrhage, which is usually slight, may be revealed or concealed. In the former case the blood escapes from the vagina; in the latter, the only symptoms are the physical symptoms of hemorrhage. If the bleeding is excessive, it tends to separate the placenta further and may cause premature labor.

If the symptoms are not severe, rest in bed for a few days in the recumbent position, with the feet elevated, and

a light diet, is all the treatment necessary. If the symptoms are severe or the hemorrhage recurs frequently, premature labor is induced by mechanical means. An ice-bag may be ordered over the probable site of the placenta. Packing the vagina, unless the bleeding point can be reached, is useless; in the majority of cases the fetus intervenes between the bleeding point.

Occurring at the time of labor, the hemorrhage may be severe. As it cannot be stopped until the birth is over, the treatment consists in hurrying the labor as much as possible. No styptics can be given until the uterus is empty, when the hemorrhage will probably be arrested by the natural contraction of the uterus. The patient's strength is spared in every way.

Hemorrhage *after* the birth of the fetus is called *post-partum hemorrhage.* Occurring at the time of labor, it is *primary;* at any time after the uterus has been contracted, *secondary.*

The *cause* is usually failure of the uterus to contract (primary) or to remain contracted (secondary), due either to retention of a portion of the placenta or of the membranes, or to uterine inertia. Hemorrhages may also occur from accidents to the uterus, such as rupture, or from laceration at some point of the birth-canal. The hemorrhage may be revealed or concealed. In the former the blood escapes by the vagina, sometimes gradually, more frequently in a sudden enormous rush. Until the uterus contracts, the large blood-vessels or *sinuses,* which have been exposed by the separation of the placenta from the uterine walls, are left widely dilated. The rush of blood may be so great that, if uncontrolled, life may be lost in a few minutes. The physical symptoms of hemorrhage are marked and develop abruptly. Through the abdominal wall the uterus is felt like an inflated balloon, instead of the hard, contracted mass it should represent.

All treatment is directed toward exciting uterine contractions. A hot intra-uterine douche (120.2° F.) of sterile water or normal salt solution is given, at the same time the abdomen is vigorously kneaded. Ergot (ergotin, 2 to 5 grains) is given by hypodermic. Contractions

have been excited in an emergency, where nothing else was at hand, by a pail of cold water thrown over the abdomen. If fragments of the placenta or membranes are retained, they are removed by hand. The hand moved forcibly around the internal wall of the uterus may also excite contractions. The necessity for absolutely strict asepsis must not be lost sight of, however great the emergency. In all labor cases the hot douche with sterile apparatus should be ready to hand. It is impossible to foresee when it may be required. When the uterus is well contracted, a pad is placed over the fundus and an abdominal binder firmly applied. The usual after-treatment in cases of hemorrhage will be necessary. The pulse must be closely watched. If it rises above 80, the binder should be undone and the abdomen again kneaded until the uterus is felt hard and firm.

Hemorrhage from a Ruptured Fallopian Tube.—The cause is the development of the embryo in one of the tubes leading from the uterus, instead of on the wall of the uterus. When the tube can extend no further, it ruptures, causing bleeding into the peritoneal cavity. The hemorrhage may be entirely concealed or partially revealed, a small trickle of blood escaping by the vagina. Sudden pain and syncope and the symptoms of shock are the usual chief indications. Though the actual hemorrhage is slight, the condition is a very grave one, recovery depending on prompt operative treatment. Septic peritonitis is a common complication from the discharge of blood and the contents of the sac into the peritoneal cavity.

Hemorrhage from the kidneys or part of the **urinary tract** is recognized by the presence of blood in the urine (*hematuria*). (See Urine, Chap. VII.) It may be due to injury or disease of the organs, or to the action of irritant or corrosive poisons.

The cause of the condition is treated. The quantity of blood lost is not sufficient to cause physical symptoms. An accident involving the pelvis, such as fracture of the pelvis (p. 627), is frequently complicated by internal hemorrhage. The condition is generally associated with profound shock. Blood may escape from the rectum or be

mixed with the urine, which should, in these cases, always be carefully saved for examination.

Cerebral Hemorrhage.—(See Paralysis, p. 695.)

Hemorrhage Due to Fracture of the Base of the Skull.—(See Fracture of Base of Skull, p. 626.)

Spontaneous Hemorrhage.—Setting on one side the subcutaneous hemorrhages already described as characteristic of certain diseases, spontaneous hemorrhage is usually associated with hemorrhagic *purpura, scurvy,* or the condition known as *hemophilia.*

Hemorrhagic purpura is a disease of unknown origin; at the present day it is considered to be not unlikely an infection. It is characterized by a profuse petechial eruption and hemorrhages from the mucous membranes; the latter are frequently so profuse as to threaten life. Accompanying symptoms are malaise and moderate fever. In very severe cases death takes place from exhaustion and loss of blood. Generally the attack lasts about two weeks. The subsequent anemia is often persistent.

The usual prompt treatment for hemorrhage will be necessary. The patient is, of course, confined to bed. The stools must be watched for traces of blood. Rest in bed, fresh air, nourishing diet, and iron for the anemia comprise the general treatment during convalescence. Gelatin or calcium chlorid are frequently ordered as preventives against further attacks of hemorrhage.

In young anemic girls spontaneous hemorrhages from the nose, stomach, or intestines may occur from time to time, usually about the monthly period, and, unless in excess, are not necessarily alarming. If severe, the attack is treated on the lines already indicated.

Hemorrhage of Scurvy.—Patients suffering from *scurvy* are likewise liable to spontaneous hemorrhages, generally from the stomach or intestines, which are treated by the usual methods. As the disease is caused by a diet deficient in fresh vegetables or milk, the diet is an important part of the treatment (Chap. XXIII). The mouth should receive special care; the gums bleed easily, and the breath has a fetid odor. An antiseptic mouth-wash should be

used frequently, especially before feeding. Fresh air and good hygiene are important factors.

Hemophilia, or **bleeder's disease,** is generally hereditary, and the family history suggests the condition. As a rule, it occurs in males, but is transmitted through the females of a family. The cause is unknown. The characteristic symptom is persistent bleeding, occurring either spontaneously or after slight injuries.

The disease is considered incurable—few bleeders grow up. A few are said to outgrow the condition. Patients with a family history of hemophilia are advised to lead lives with as little exposure to injury or overexcitement as possible, and should not undergo operations if they can possibly be avoided.

Hemorrhage from so slight a cause as the drawing of a tooth may prove so persistent as to cause death from exhaustion.

The attack of hemorrhage is controlled by the usual methods, but is often very intractable, breaking out again and again after the vessel has been closed by pressure, the application of styptics, etc. Hemostatics are generally given internally at the time of the hemorrhage. A course of gelatin or calcium chlorid is frequently ordered.

PERFORATION

By *perforation* is generally understood a complete rupture at one point in the wall of the intestines or the stomach (the latter is less common), resulting in escape of the contents of that portion of the alimentary tract into the peritoneum. Perforation may occur as the result of direct injury; after an operation on the intestines from sloughing of the tissue; and, the most usual cause, from the burrowing of an ulcer through the wall of the intestine or stomach.

The **symptoms** are sudden pain (not always present), abdominal distention (*tympanites*), sudden fall of temperature if it has previously been elevated, with rapid, feeble pulse and marked symptoms of shock.

The **treatment** is instant operation. While surgical aid is being obtained the patient should be kept at abso-

lute rest in the recumbent position, with the head low, and external heat applied. If a stimulant is ordered it is usually strychnin and is given by hypodermic. Nothing is given by mouth and all previous treatment is stopped.

The dangers of perforation are fatal shock and septic peritonitis. The latter develops rapidly from decomposition of the food substances, which have escaped into the cavity of the peritoneum. It is in order to avoid this complication that prompt operation is necessary.

The operation consists of irrigation of the peritoneum and repair of the perforation. After the operation morphin is usually ordered and the alimentary tract kept at absolute rest for three or more days. For the same time all movement of the body is forbidden. Fluid diet is then begun in small quantities. The bowels are relieved by enemata and all griping laxatives avoided.

CHAPTER XVIII

NURSING IN ACCIDENTS AND EMERGENCIES (Continued)

Fractures: Varieties; Union; Immediate Treatment; Surgical Treatment; Pott's Fracture; Colles' Fracture; Fractures of Ribs; Skull—Vault, Base; Jaw; Pelvis; Spine. Dislocations: General Treatment; Jaw, Finger; Sprains; Wounds: Varieties; Healing of; Treatment; Dressings—Complications: Inflammation; Infection; Abscess; Blue Pus; Cellulitis; Slough; Gangrene; Embolism—Special Infections: Erysipelas, Scarlet Fever, Tetanus.

FRACTURES

A fracture is commonly described as a "break in the continuity of a bone." It is caused by direct or indirect violence or by the sudden contraction of powerful muscles.

Violence is said to be *direct* when it causes a lesion at the immediate site of injury, as in a fracture caused by a blow or a gun-shot wound, etc.

In *indirect violence* the lesion occurs at a distance from the immediate site of injury. Thus, a fracture of the clavicle may be caused by a fall on the shoulder. An example of a fracture due to *muscular contraction* is that of a fractured patella in consequence of a fall on the feet, and directly due to the instinctive strong contraction of the quadriceps muscle in the common tendon of which the patella is contained.

Varieties.—According to the direction of the fracture, it is described as *transverse, oblique,* or *longitudinal.*

In long bones the fracture may occur at the shaft (*diaphysis*), at the ends (*epiphysis*), at the *head*, or at the *neck*. For convenience, the shaft of the long bones of the extremities is usually described in three parts—the upper, middle, and lower thirds. A fracture at the *epiphysis* separates the head from the shaft.

Fractures at the neck of a long bone are described as *intracapsular*, if occurring inside the capsule that incloses the joint; or *extracapsular*, if occurring outside the capsule. Intracapsular fractures are liable to result in *ankylosis*, or permanent rigidity of the joint.

Symptoms.—The characteristic symptoms of a fracture are: Sudden pain, in connection with a history of violence, deformity, abnormal movement, swelling and discoloration of the surrounding tissues (due to extravasation of blood), crepitus or a grating sensation if the fractured ends are moved on each other, and interference with function. The function of the bones of the extremities is support and movement. When such a bone is fractured, it cannot be used to support the body, and voluntary movement below the seat of fracture is either lost or restricted. In fractures of the extremities the injured limb is frequently altered in length in comparison with the sound limb; if the fracture occurs at or near a joint, there is, usually, a characteristic dislocation of the joint.

Fractures of the brain, pelvis, or spine are complicated by injuries to the adjacent structures, giving rise to special symptoms.

Classification.—Fractures are divided into two chief groups—*simple* or *closed*, and *compound* or *open*.

In a **simple** or **closed fracture** the injury is subcutaneous, the external tissues protecting it from contact with the air. Flesh wounds may exist, but do not form a channel of communication between the fracture and the surface. As long as a fracture remains simple, it is protected from infection.

In a **compound** or **open fracture** there is also an open flesh wound, forming a direct channel of communication between the fracture and the surface. The fractured bone can be reached through the wound. A compound fracture is usually due to direct violence.

Besides the two chief groups, fractures are also subdivided according to certain characteristics.

Greenstick Fracture.—This is one in which the bone is bent and only partially broken. Greenstick fractures

are common in the long bones of children, the bones being soft and easily bent.

Comminuted Fractures.—A fracture in which the bone is splintered into several pieces. A comminuted fracture is more often also compound.

Impacted Fractures.—A fracture in which the broken ends are forcibly driven together, or *impacted,* at the time of injury. Impacted fractures are usually simple, and occur chiefly in long bones as the result of indirect violence, as, for example, in a fall where the weight of the body is received on the outstretched limb.

Fig. 196.—Compound fracture ("American Illustrated Medical Dictionary").

Fig. 197.—Partial or greenstick fracture of the radius.

Multiple Fractures.—A fracture of one bone in two or more separate places.

Complicated Fractures.—A fracture is said to be complicated if it is associated with serious injury to some important adjacent structure, such as the rupture of a large blood-vessel or injury to an internal organ.

Depressed Fractures.—A fracture in which the broken fragment is forcibly driven inward against the underlying structures. Depressed fractures are the result of direct

violence and are frequently compound. They occur in fractures of the skull and upper jaw.

Physical Symptoms.—Besides the local symptoms and those arising directly from injury to important structures, as, for example, compression of the brain, a fracture is usually accompanied by certain *physical symptoms*, more or less marked according to the circumstances of the accident and the condition of the general health. Some shock is always present, and may be severe. Slight fever, malaise, and gastric disturbances are generally present during the first few days. The condition is treated by rest, quiet, a purgative, and light diet. Severe shock is a prominent symptom in fractures of the pelvis and the skull. In alcoholic subjects mental excitement and insomnia are common symptoms. They are usually treated with sedatives, in order to prevent the development of delirium tremens.

Fig. 198.—Comminuted fracture of the tibia ("International Text-Book of Surgery").

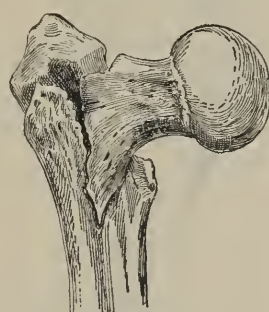


Fig. 199.—Impacted fracture of the neck of the femur (Da Costa).

The Repair of Fractures.—The time allowed for the union of a fractured bone varies with the size and importance of the bone and its position in the body.

A fracture of a bone of a finger will unite in about two weeks, while for a fracture of the neck of the femur, a

bone that has to bear the whole weight of the body, from ten to twelve weeks are allowed.

Repair of a fracture takes place by the deposit of new bony tissue, to which the name *callus* is given. The first callus is temporary or *provisional*, and resembles cartilage; it first forms on the outside of the fractured ends, incasing them like a natural splint, and later between the broken fragments, thus forming a *temporary* union. From the provisional callus a permanent callus is developed between the fractured ends of the bones, forming what is known as *bony union*. The provisional callus is gradually absorbed in the process of healing. In large bones about twelve months, it is considered, is required before the permanent callus is as strong as true bone.

Fig. 200.—Callus of fracture (dog) four weeks; commencing ossification of external callus (Warren).

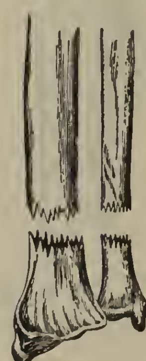


Fig. 201.—Appearance of the ends of fragments (Da Costa).

In some instances bones fail to unite. The usual causes are imperfect approximation, either by careless "setting"

or from failure to keep the fragments at complete rest, disease of the bone, or suppuration.

Imperfect approximation may result in the deposit of fibrous tissue instead of bony tissue between the broken ends, forming what is known as fibrous union. This is especially liable to occur in fractures of the patella where a fold of the periosteum is apt to intervene between the divided fragments. Fibrous union is useless for the purpose of bone function. Permanent deformity and shortening of a limb are also results of imperfect approximation. Union may be *delayed* by physical conditions which affect the health of the patient. For malunion the treatment usually is to break the bone afresh and reset the fracture.

For cases of delayed union a surgical operation is frequently performed, and the fragments either wired or screwed together.

In aged people bony union does not commonly take place. If the patient recovers from the shock, he is usually moved out of bed on to a chair as soon as the symptoms of pain and inflammation have subsided, otherwise he may become bedridden. Whenever possible, such patients should be induced to learn to walk with crutches.

Other complications that may arise from a fracture are as follows: Extensive sloughing of the adjacent soft tissues, destruction of bone, resulting in the formation of sequestræ, hemorrhage, either primary or secondary (see Hemorrhage), embolism (see Embolism), painful callus, caused by the pinching of a nerve, and infections, either local, causing suppuration, or general, as septicemia, erysipelas, and tetanus. As in all violent accidents, delirium tremens is a common complication in alcoholic patients.

TREATMENT OF FRACTURES

Immediate Treatment.—Wherever a fracture occurs, temporary means should be taken to keep the part at rest until surgical help can be obtained, otherwise injudicious movement will increase the hemorrhage and

may cause serious injury to the adjacent structures, such as rupture of a large blood-vessel, or convert a simple fracture into a compound one. For the same reasons no attempt should be made by the bystanders to reduce or "set" the fracture, however apparent the deformity; where practical, the injured member may be elevated and cold applied over the seat of the fracture. This will help to control the hemorrhage, check the inflammation, and relieve the pain. Very frequently it is necessary to transfer the patient before surgical aid can be procured. In these cases temporary support of the fracture must be given.

For a *fracture of the leg* (p. 250) the limb may be extended on a pillow or folded coat, in as straight a position as can be obtained without force. Outside the pad so formed temporary splints made of boards, walking-sticks, rolled newspapers, etc., are placed, and the whole tied securely round the limb immediately above and below the seat of fracture, and again above the knee and round the foot.

A fracture of the *forearm* may be treated in the same way. If the patient must walk, the elbow should be flexed and the forearm supported in a sling. In a fracture of any part of the *femur* the patient must be kept perfectly flat and transferred on a stretcher or board. If possible to devise a temporary splint, it should be applied on the outside of the injured member and extend from the axilla to beyond the foot. It should be kept in position by ties passing round the body and round both lower extremities, the uninjured leg thus acting as a second splint. A board must be kept under the pelvis.

A fracture of the *upper arm* is usually best secured by placing a flat pad between the arm and the body, and pinioning the arm firmly against the side with a stout towel secured by several pins. To be correct, the position should be comfortable. If there is deformity about the shoulder, or if the patient must walk, the forearm may be supported in a sling. Should the elbow be affected, a temporary splint should be devised and applied on the inner surface of the elbow, so that the joint is kept extended.

In a fracture of the *clavicle*, usually due to indirect violence from a fall on the shoulder or outstretched arm, the shoulder is dropped and the patient's head is turned to the injured side; he cannot raise the hand to his head. He should lie flat, with the arm extended by his side. If it is necessary for him to walk, a pad should be placed in the axilla and the hand brought over and held on the opposite shoulder. In this position a stout towel is pinned round the body over the affected arm. The elbow should be supported by the free hand. If the movement causes pain or appears to increase the deformity over the clavicle, it is better to allow the arm to hang, fixing it to the side with a broad towel. A small pad should be placed in the axilla.

If a *rib* is fractured, the patient should be transferred with as little movement as possible. The initial injury may be slight, but injudicious movement may result in puncture of the pleura or of the lungs (see below). The local pain is commonly acute. A towel pinned firmly round the chest will help to minimize the movement of the chest-wall in the act of breathing.

In *compound fractures* there is also the open wound to be treated. It rarely occurs that the means of treating it by aseptic methods are immediately at hand. If a sterile dressing can be had or devised, as by boiling a clean handkerchief, the wound can be temporarily dressed. Otherwise it is best left untouched, loosely covered with the cleanest article obtainable, and guarded carefully, as far as possible, from contact with soiled clothing or outside matter, particularly from contamination by soil, since in soil the bacillus of tetanus is frequently found.

Should it be necessary to *remove clothing*, the injured limb should be steadily supported above and below the seat of fracture. It is *rarely* necessary to cut away and destroy the clothes. In removing trousers or a coat, the uninjured limb must first be divested; the garments can then be drawn over the injured limb with a minimum amount of movement or pain.

In the suspected fracture of the *skull* (especially the base), the *spine*, or the *pelvis*, the patient should be placed

in bed in the recumbent position with as little movement as possible. To raise him, a sheet or blanket, if procurable, should be rolled beneath him, by the four corners of which he can be lifted on an improvised stretcher. The clothing should be loosened, but no attempt made to remove it until expert help can be obtained. Shock is always a feature of such accidents. It is treated by the recumbent position, with the head low and external warmth. Stimulants may be necessary if the patient is *in extremis*. They must, however, be given with caution, as they increase the hemorrhage.

In accidents to the *spine*, pain and sensation of all kind will probably be absent, owing to the paralysis involved; none the less, movement may greatly aggravate the injury.

In a fracture of the *pelvis* the patient can neither stand nor sit. If such an injury is suspected, the thighs should be flexed by pillows placed below the knees, and cold may be applied to the lower part of the abdomen.

In severe injuries to the skull the patient is generally unconscious. Cold may be applied to the head and all noise and bright light should be excluded. Should a patient be *unconscious*, his head must be carefully kept turned to one side. The reason, of course, is that already emphasized—to prevent any vomited matter from falling into the larynx, since an attack of vomiting is a common accompaniment of reaction from shock.

Surgical Treatment of Fractures.—The local treatment of a fracture consists, where practical, in the proper approximation of the broken ends by manipulation or traction. The process is familiarly known as "setting the bones." If the deformity is great or there is spasm of the muscle, it is frequently necessary to administer an anesthetic in order to reduce the fracture. After the reduction of a fracture in the shaft of a bone a splint that will keep the fractured fragments in proper position is applied. Provided the part is at rest in a good position, there is not usually any necessity to hurry in the setting of a simple fracture. A day or even two is frequently

allowed to elapse between the injury and the reduction. (See Splints, etc., Chap. VIII.)

In *applying a splint* it must be remembered that the joint above and below the fracture must also be kept at absolute rest, and a splint large enough to extend generously beyond the joints should be selected. As a rule, in bandaging the splint to the limb the bandage is applied above and below the seat of fracture, leaving the injured area free from pressure.

Fractures at or near an important joint are frequently treated by extension (p. 281), either with or without splints. Extension treatment is also usually preferred in fractures of the femur higher than the lower third. The patient remains in bed. If the mattress is a spring mattress, or liable in any way to sag, it must be stiffened with fracture-boards (p. 284); if the fracture is to any part of the lower extremity, sagging of the mattress may interfere with proper approximation.

Until the swelling is reduced, cold, usually in the form of the suspended ice-bag, is frequently applied over the injury. In extensive contusions cold is contraindicated (p. 79). Blisters frequently form over the contused area. Generally they are protected from breaking with a light pad of cotton, and allowed to reabsorb. If they become broken, they form a channel for infection, and must be dressed at once with aseptic methods.

At the end of a period that varies with the extent of the injury and the position of the bone in the body, the splints are removed and replaced by a stiff bandage or a plaster cast (Chap. VIII), which is retained until union is perfect. In fractures of the lower extremity the patient is then usually able to get about on crutches.

In fractures occurring at or near a joint, with the exception of the hip and the vertebræ, light massage and gentle passive movements are frequently prescribed as soon as the preliminary swelling has subsided, in order to promote absorption of inflammatory products and prevent the formation of adhesions.

Two fractures very frequently met with are known as

Pott's fracture and *Colles' fracture;* both are serious accidents complicated by dislocation of an important joint.

A **Pott's fracture** is a fracture of the fibula just above the malleolus, and accompanied either by fracture of the tip of the inner malleolus (of the tibia) or by rupture of the internal lateral ligament. There is a characteristic dislocation of the ankle, turning the foot outward (*eversion*). On account of the dislocation of the ankle the reduction of a Pott's fracture requires special care and is usually performed under an anesthetic. It is of great importance that a correct position should be maintained, or permanent crippling and deformity may result. A well-fitting back and side splint may be used, or a Dupuytren straight splint may be preferred (p. 278). When the inflammation has subsided the splint is generally replaced by a plaster cast. Light massage and gentle passive movements are commonly ordered at an early date.

Fig. 202.—Pott's fracture ("American Illustrated Medical Dictionary").

Not infrequently a Pott's fracture is compound. If suppuration occurs, ankylosis of the ankle-joint will probably result.

A **Colles' fracture** is a fracture of the lower end of the radius, accompanied by a characteristic dislocation of the wrist, often called, from its appearance, the "silver-fork" dislocation. It is caused by falling on the outstretched hand. The hand is dislocated backward and drops toward the ulnar side. The broken fragments are frequently impacted. A characteristic symptom is an acutely painful spot over the fracture.

Reduction of the dislocation and the setting of the fracture are generally done under an anesthetic, and a special, closely fitting splint applied. (See Bond's, Levis' Splints, etc.) Massage and gentle passive movements are generally begun early—sometimes at the end of the first week.

By a **fracture of the knee,** fracture of the *patella,* or knee-cap, is understood. Frequently it is caused by sudden violent contraction of the quadriceps muscle, as in saving from a fall. Unless bony union is obtained, permanent lameness results. Fibrous union is a not infrequent occurrence, especially where the periosteum remains intact; a fold of the periosteum is very liable to fall between the broken fragments. To prevent this, it is often necessary to "wire" the patella; or the broken fragments are brought together by hooks, known as Malgaigne's hooks. If operative treatment is not necessary, a posterior splint

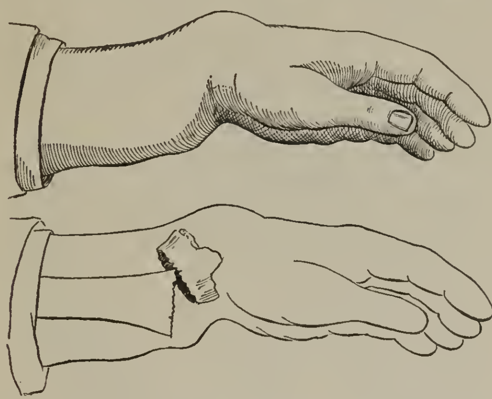


Fig. 203.—Colles' fracture, showing characteristic deformity (silver-fork deformity) at the wrist, due to backward displacement of the lower fragment (Levis).

is applied, the fragments are approximated, and held in position by strips of adhesive plaster adjusted above and below the seat of fracture, as in a tortuous bandage (p. 254), and fastened to the posterior splint; above the plaster a figure-of-8 bandage is applied. The extremity is then placed on an inclined plane, the leg extended, and the thigh flexed.

Light massage of the knee-joint, with gentle passive movements, is frequently ordered at an early stage of convalescence.

A **fractured clavicle** (see above) is usually treated by the application of a Velpeau bandage or by Sayre's method

of adhesive strapping (p. 287). The arm is kept in position for three weeks, but if the physical condition permits, the patient is allowed to walk and move about freely. In some instances these methods fail to obtain perfect approximation. The treatment then consists in keeping the patient flat on the back on a mattress stiffened by fracture-boards, with the arm straight to the side. A pad is placed in the axilla to raise the shoulder, and the position is maintained by sand-bags placed on either side of the body. A small sand-bag is also placed against the head on the affected side, to correct the rotation toward the shoulder. A second small pad may be necessary between the shoulder-blades to keep the shoulder back. The fixed position is one of considerable discomfort; great care is necessary to prevent the formation of a bed-sore.

Fractured ribs are treated by strapping the affected side or by the application of a broad bandage to the chest (p. 287). Coughing and dyspnea are symptoms of injury to the pleura. If accompanied by blood-stained expectoration and the symptoms of shock, the lung has probably been damaged. A fracture puncturing the lung is a *compound* fracture, although there may be no external wound. Through the lung the broken fragments are in communication with the outer air. The pleura is a closed cavity; a fracture involving only the pleura is *complicated*, but not compound.

Complications that may arise from a fractured rib are pleurisy, pneumonia, hemothorax, empyema, and pneumothorax. A rise of temperature, with quickened respiration, cough, and expectoration, are symptoms to be promptly noted.

The **skull** may be fractured at the vault or the base. Fractures of the vault are due to direct violence. When simple, and if not depressed, they may easily be overlooked; their importance lies in the injury they may cause to the underlying structures, the meninges, or the brain. Unless there are symptoms of injury to the brain or compression, no treatment is considered necessary. With these accidents there is usually some concussion. A purgative is

administered, and the patient is kept in bed as long as the symptoms last.

A **compound fracture of the vault** is generally depressed and frequently comminuted; in some cases the bone is also punctured. It is a serious accident, both on account of the immediate injury to the brain and the danger of subsequent inflammation or infection involving the brain. If the fracture is depressed, there may be symptoms of brain compression, of which the first symptoms are vomiting, headache, restlessness, a slow, full pulse, facial congestion, and contracted pupils. Later symptoms are

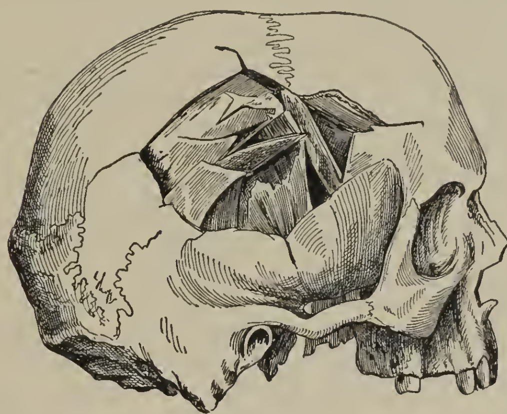


Fig. 204.—Comminuted fracture of the skull (Hoffa).

unconsciousness, stertorous breathing, rise of temperature, slow pulse with high tension, dilated pupils, profuse perspiration, and paralysis with involuntary evacuations. Epileptiform convulsions may occur, or profound coma, passing into collapse. Retention of urine is common, and should be relieved by the catheter. Some concussion is commonly present.

Shock may be a prominent symptom, even in cases where the local injury is not great, and is treated by the recumbent position and external warmth. Stimulants are avoided as much as possible. A quickly acting purgative is usually given at once (croton oil, 1 to 3 minims).

If the patient is drunk, lavage is generally performed. The surrounding area of the head is shaved and washed. The wound is thoroughly cleansed, the clots and every particle of foreign matter patiently removed. In many cases the wound can be brought together with stitches, leaving, as a rule, an opening for drainage. For depressed fracture or fractures in which the bone is punctured, a surgical operation is necessary. Depressed fractures are *elevated;* an injured bone is removed by *trephining.*

Complications, usually fatal, of a compound fracture of the vault are septic inflammation, which generally involves the meninges, and the formation of a thrombus in one of the cerebral vessels.

The patient should be nursed in a quiet room, with the light shaded and all disturbances or excitement avoided. The head of the bed is elevated, or the head may be raised on pillows. The most important point is to keep the wound aseptic, and to prevent risk of hemorrhage from sudden movements. The diet is liquid until convalescence is established. The bowels must be kept active. Symptoms for which special watch should be kept are twitchings of the muscles, convulsions, paralysis, and sudden changes of the pulse or temperature. The blood-pressure is an important indication of the condition in all cases of brain compression; in nursing such cases a nurse may be expected to take the pressure with the *sphygmomanometer* (p. 162).

Fractures of the *base of the skull* are the result of indirect violence, commonly a fall. The immediate symptoms are those of shock and violent concussion, and may be mistaken for drunkenness. Symptoms of compression of the brain develop rapidly, as just described. In severe injuries consciousness is not regained from the first concussion, and the patient passes into a profound coma which ends fatally in a few hours. Characteristic diagnostic symptoms are a discharge of blood or clear fluid (cerebral) from the ears, nose, or mouth, and unequal dilatation of the pupils, that on the affected side being widely dilated. Later there is ecchymosis (discoloration due to subcutaneous escape of blood) round the orbits and over the

mastoid process, and suffusion of blood in the conjunctiva. It must not be overlooked that external traces of blood may be due merely to local injuries.

The fracture is *simple;* blood or fluid, however, escaping by the cavities, forms a channel of communication between the injury and the outer air, and may be the means of infection. Where the ears discharge, the external ear or nostril should be carefully cleansed by aseptic methods and the openings lightly plugged with sterile absorbent cotton.

The physical symptoms are treated with rest in the recumbent position, in a darkened room, and an ice-bag applied to the side or back of the head. For threatened collapse stimulants are given, but are avoided otherwise. Complications to be apprehended are inflammation of the brain or meninges, and cerebral thrombus. Persistent coma with high temperature are regarded as fatal symptoms. If recovery takes place, the mental faculties are frequently impaired.

Fracture of an orbit may result from indirect violence, and is serious on account of the risk of injury or inflammation to the eye, the optic nerve, or the adjacent portion of the brain.

The patient is kept at complete rest in the recumbent position. The light is shaded, and the use of the eye forbidden until convalescence is established. The local treatment is according to the extent of the injury; an oculist should be consulted. Constant cold compresses are frequently ordered to the eye in the first instance, and the pupil is dilated with atropin.

Fracture of the lower jaw is generally accompanied by injury to the tissues of the mouth, displacement of the teeth, and bleeding from the mouth. Where the injury is severe, it is often necessary to wire the bone. The jaw is supported by a Barton bandage or a close-fitting splint made of hard rubber or poroplastic felt is applied. (See Splints.) An antiseptic mouth-wash must be constantly used. Liquid diet is necessary for about six weeks, by which time union has usually taken place.

Fractures of the Pelvis.—A fractured pelvis may result

from a severe fall or from crushing of the parts, as when the patient is run over by a vehicle. The prominent symptoms are those of severe shock and acute local pain; the patient is unable to stand or to sit. Internal hemorrhage from injury to a blood-vessel or rupture of one of the pelvic organs may occur. The urine should be kept for examination; frequently it contains blood from injury to the genito-urinary organs.

The patient is placed flat on his back on a mattress straightened by fracture-boards. The thighs are flexed by pillows placed below the knees; a binder or wide bandage is secured round the pelvis. If the patient is restless, sand-bags may be placed on either side, and a roller towel be passed over the pelvis and under either sand-bag. Where permissible, pressure on the coccyx should be guarded against by the use of a rubber ring cushion, very slightly inflated. *Nothing* must be given by mouth until the extent of the injuries has been ascertained.

The chief immediate treatment is directed toward combating the effects of shock and controlling hemorrhage. Elevation of the bottom of the bed, hypodermoclysis, or intravenous infusion are the usual means. A bed-cradle is necessary to keep the weight of the clothes from the pelvis; at the same time care must be taken that the chest and extremities are warmly covered. An ice-bag may be suspended from the cradle over the lower part of the abdomen. Stimulants are given with caution on account of the possible hemorrhage. Opium is generally ordered to relieve the pain and allay restlessness.

Fractures of the pelvis are, in the majority of cases, fatal, either from the immediate shock, from internal hemorrhage, or from injury to one of the pelvic organs. Rupture of the bladder is shown by the extravasation of urine into the surrounding tissue. Where the condition of the patient permits, a surgical operation is performed and the bladder repaired. If the patient lives over a few days, septic peritonitis or perforation is a common complication.

Such cases require skilled nursing. Where there are evidences of internal injuries or hemorrhage, the patient

must not be turned, and any movement must be the slightest possible. A slipper bed-pan may be used; if not procurable, the motions should be passed on pads of tow. Liquid nourishment is given, usually in small quantities at a time. For excessive thirst, sips of boiling hot water or hot tea are preferable to cracked ice. Close watch must be kept for such symptoms as shivering, sudden abdominal pain, distention, rapid rise of the pulse, sudden alterations in the temperature, and syncope. Bed-sores can be prevented only by constant vigilance and cleanliness. (See Bed-sores.)

Fracture of the Spine.—A fracture of the spine may be due to direct or indirect violence. Commonly, they are simple fractures, but as the result of a violent accident involving crushing or tearing of the soft tissues they may be compound. They are invariably complicated by some injury to the spinal cord. Usually dislocation is also present. The characteristic feature of injuries to the spinal cord is paralysis, both sensory and motor, on both sides of the body (paraplegia), below the seat of injury, with marked hyperesthesia above. Control of the sphincter is lost, and the urine and bowel movements are passed involuntarily. In severe lesions of the upper cervical vertebra death occurs instantaneously from paralysis of the respiratory muscles of the chest.

The gravity of the condition depends on the extent to which the spinal cord is involved. In favorable cases the cord remains intact, and the paralysis is due to the pressure caused by the extravasation of blood and serum. There is no persistent dislocation. The limbs gradually regain their movements, and complete recovery, except for some local stiffness of the column, usually takes place.

In the majority of cases the injury involves twisting or tearing of the spinal cord. Partial recovery with paraplegia may take place; most commonly the patient dies, either from shock during the first twenty-four hours, or, after lingering weeks or months, from exhaustion or one of the complications of the condition. Common complications are cystitis, bed-sores, bronchitis, and hypostatic pneumonia. Compound fractures are usually quickly fatal,

either from shock or hemorrhage, or later from septicemia or meningitis.

Where it can be procured, the patient should be nursed on a water or an air mattress, below which fracture-boards are placed. Scrupulous care is necessary to prevent bed-sores, as, owing to the paralysis of the sphincters, it is difficult to keep the bed clean or dry. After the immediate symptoms of spinal irritation have subsided, permission is generally given to turn the patient at intervals, beginning with once or twice a day, and gradually with greater frequency. Turning not only removes constant pressure, but also lessens the risk of hypostatic congestion of the lungs. In turning, the spine must be kept rigid by careful support above and below the injury, otherwise movement may at first cause acute local pain, and increase the injury to the spinal cord.

The bladder is emptied at regular intervals by the catheter. To some extent, by careful management in the administration of laxatives and the use of enemata, the action of the bowels can be regulated and a daily evacuation at a regular hour effected. If cystitis occurs, the bladder is irrigated daily. Variations of the pulse and temperature, attacks of acute pain, and fits of mental depression or excitement commonly accompany the condition in its progress.

The hygiene should be as good as can be obtained. The diet is liquid until the preliminary symptoms are passed; later it should be varied and nourishing, and tonics are usually prescribed. If recovery takes place, regular light massage and passive movements may be ordered to the lower extremities, in order to promote nutrition and prevent rigidity or contraction.

In some cases an attempt is made to relieve the pressure by a surgical operation involving the removal of a portion of the vertebral arch. The operation is known as *laminectomy*. In other cases extension apparatus and the spinal jacket are used to overcome the local dislocation.

In the treatment of a compound fracture the wound is dressed daily with strict aseptic precautions, and every care taken to keep the area free from infection. In other respects the treatment is the same as for a simple fracture.

DISLOCATION OR LUXATION

A dislocation is a persistent separation of the articular surfaces of two or more bones, the articulation of which constitutes a joint. It is accompanied by a wrenching of the tendons and ligaments, and frequently by injury to the adjacent soft tissues. A dislocation in which the bones are immediately replaced is called a *sprain*.

Varieties.—Dislocation may be complete or incomplete (*subluxation*). Like a fracture, a dislocation is said to be *simple* or *closed*, when unconnected with a wound, and *compound* or *open*, when combined with a flesh wound communicating with the surface. A dislocation is described as *complicated* if, together with the dislocation, a fracture exists, or a serious injury to important structures, as, for example, a dislocation of the spinal vertebræ, involving pressure on the spinal column. According to the position of the displaced bones, a dislocation is described as forward, backward, or to either side.

The **symptoms** of a dislocation are *deformity*, *pain*, and *rigidity;* voluntary movement is either restricted or lost; passive movement causes severe pain; the surrounding tissues become swollen and discolored. A dislocation is distinguished from a fracture by the absence of crepitus or abnormal mobility.

Dislocation may be due to congenital deformity, or the result of traumatism, disease of the bone, or violence, direct or indirect.

The **reduction of a dislocation** means the replacement of the bones in their proper position, so that the function of the member is not impaired. Manipulation, traction, and the use of extension or counterextension are the means employed. When reduced, the parts are kept in proper position by the use of appropriate splints and bandages. Those used in the treatment of a fracture near a joint are usually applicable in the treatment of a dislocation. The part is kept at rest until the wrenched ligaments or other injury to the soft tissues are repaired, after which passive movements and massage are usually prescribed. Gentle massage without passive movement is often prescribed early in the treatment.

If not properly reduced, a dislocation may result in permanent deformity, with more or less crippling. Inexpert assistants should be careful to make no attempt at reduction, as they will probably only increase the injury. Until surgical aid can be procured, the limb should be supported in as comfortable a position as possible, and cold compresses or an ice-bag applied to the part, in order to reduce the swelling and relieve the pain. Hot applications may be preferred if the pain is severe.

Fig. 205.—Subcoracoid dislocation of the humerus (Hoffa).

While a fracture can, without injury, usually wait hours or even one or two days before being set, a dislocation requires prompt treatment. If not seen until extensive swelling has occurred, reduction may be impossible. By the time the swelling has subsided, a growth of new tissue has taken place between the disarticulated ends of the bones, forming what is known as a fibrous joint, which is useless for the purpose of function.

A **compound dislocation** is a serious condition. If the wound becomes infected, ankylosis of the joint with

permanent crippling will probably result. The wound from the moment of injury must be treated with strict aseptic precautions. The patient's health is usually built up with liberal diet and tonics, in order to increase his resistance to bacterial invasion.

Dislocation of the lower jaw is a minor ill that may frequently be reduced without much difficulty. The jaw should be taken between the two hands, the operator standing directly in front of the patient. The thumbs are

Fig. 206.—Dislocation of the lower jaw.

placed inside the mouth, over the molar teeth, as far back as possible. Steady pressure is then made downward and backward until the bone slips into its socket. If any considerable time has elapsed between the occurrence of the dislocation and its reduction, a small blister is usually applied immediately over the joint to prevent exudation. A jaw bandage is sometimes applied for a few hours.

Dislocation of a finger is often reduced by grasping the hand and pulling the finger firmly and in a straight line from the hand. A finger splint should then be applied and a cold wet dressing to keep down swelling.

Sprain.—A sprain may be described as a dislocation that is immediately and automatically reduced. The extent of injury in a sprain varies greatly. The displace-

ment may have been so severe as to cause severe wrenching or tearing of the ligaments and tendons. In these cases there are severe pain and much local swelling and discoloration, and it is frequently difficult to determine whether the condition is one of sprain or fracture.

A severe sprain should be kept at rest, the joint elevated, and either hot fomentations or cold evaporating compresses applied. When the swelling has subsided, a splint or plaster-of-Paris bandage is applied and retained for one or two weeks, after which massage and passive movements are generally ordered, and the joint gradually accustomed to use.

For slighter injuries a wet bandage is generally applied, and over it a compress of evaporating lotion, which is constantly renewed. After six to twelve hours massage and passive movements are given, and the bandage and compresses reapplied. In the case of sprained ankle, gentle exercise, helped with a walking-stick, is generally advised as soon as possible in spite of pain. Instead of the cold compresses, hot fomentations may be used or the joint may be douched alternately with very hot and very cold water.

Another method of treatment, especially in sprains of the ankle, if it can be applied immediately, is to strap the joint (Chap. VIII). In this case the patient is generally encouraged to exercise the joint in moderation.

WOUNDS

A wound or *trauma* is described as a " solution in the continuity of the soft tissues " caused by violence. Though impaired, the tissues are not destroyed, as in the case of burns.

According to the character of the injury, they are classed as *incised, lacerated, contused,* or *punctured.*

An **incised wound** is inflicted by a sharp cutting instrument. The tissues are sharply divided. Hemorrhage is commonly present. If a wound is deep, important structures, such as tendons, large blood-vessels, or an entire muscle may be divided.

A lacerated wound is one in which the tissues are torn apart. Usually there is not much hemorrhage, as torn arteries tend to contract, and the surfaces thus roughened favor the formation of blood-clots. The surrounding tissues are generally bruised. Lacerated wounds are common in accidents caused by machinery. An animal in biting also inflicts a lacerated wound.

A **contusion** is a bruise. Contused wounds may comprise a slight bruising or complete crushing of the parts. They are inflicted by direct violence, such as a blow from a blunt instrument or a severe beating.

In a **punctured wound** the tissues are pierced by a pointed narrow instrument, frequently a sharp-pointed nail or splinter of wood. They are also caused by a gunshot. The instrument inflicting the wound is frequently left, whole or in part, in the wound. There is little hemorrhage, and the immediate injury to the tissues is often slight. Punctured wounds are peculiarly liable to certain bacterial infections, especially infection by the tetanus bacillus.

Healing of Wounds.—Where the tissues have been divided, the wound is closed or healed by the formation of fresh tissue, which grows from the cells of the underlying connective tissue. The tissue so formed is spoken of as *scar tissue.* On the surface of the body, when fully formed, it is at first pinkish, and finally has a white, shiny appearance. Scar tissue is inelastic, and has neither hair-follicles nor secretory glands. In the young only it may become to a certain extent covered with true skin.

Where the divided surfaces of a wound can be brought together and kept in close apposition, little new tissue is necessary, and healing takes place very quickly. Healing is then said to take place by *first intention*, or, in other words, *primary union* results. In primary union there is no inflammation, the surfaces of the wound appear to become glued together. Where the edges of a wound are finely adjusted, scarring is very slight.

When there is destruction as well as separation of the tissues, primary union is not always possible. The wound then heals by a process known as *granulation.* Healing is then said to be by *secondary union.*

A *granulation* is a minute process or new cell developed from a connective-tissue cell. Starting from the sides and bottom of a wound, the granulations grow slowly until the cavity of the wound is completely filled and level with the surface.

A healthy granulation looks like a minute bright-red speck. Unhealthy or *indolent* granulations look pale and flabby. They are then stimulated by such applications as balsam of Peru, borine, oxid of zinc, or a weak solution of nitrate of silver.

In some wounds granulations grow too rapidly, forming an uneven surface; they may be burnt away or *reduced* by applications of nitrate of silver stick or of blue stone (sulphate of copper). Too free granulation is described as *redundant.*

When extensive surfaces heal by granulation, the inelastic scar tissue is apt to cause contraction of the parts. If the wound is near a joint, permanent crippling may result. The condition is guarded against in the treatment by the application of suitable splints or extension, and the early practice of passive movements. A deep wound may show a tendency to close at the top before healing is complete. The mouth has then to be kept open by a drainage-tube or a strip of gauze, etc.

In flat superficial wounds healing takes place first from the margins and later from isolated spots over the surface of the wound. The granulation presents the appearance first of a red line, with, as healing progresses, an outer blue line forming a ring inclosing the wound. The ring gradually advances toward the center, leaving behind the freshly grown scar tissue. The healing of large superficial wounds is frequently hastened by the process of skin-grafting.

TREATMENT OF ACCIDENTAL WOUNDS

The treatment of all such wounds comprises: (1) The arrest of any hemorrhage; (2) the perfect cleansing of the part and adjacent tissues, including the removal of all foreign matter; (3) the placing of the part at rest; (4) the repair of the tissues.

The possibility of *shock* must not be overlooked, and the

patient, as a matter of routine, should be spared unnecessary standing or sitting upright or exposure to cold, such as waiting in a draughty hall. For the same reason wounds should be treated promptly. A point to be emphasized is that the tissues must be gently handled to avoid further bruising. Not only will the process of repair be prolonged, but bruised tissues are considered to present reduced resistance to bacterial invasion.

Hemorrhage is arrested by one or other of the methods already described. Where possible, the bleeding vessels are tied.

The thorough *cleansing* of a wound is probably the most important factor in recovery, whether the wound is small or great. The adjacent parts should be scrubbed with hot soap and water and covered with a sterile towel wrung out in an antiseptic solution.

The wound is then gently and thoroughly washed, if free from foreign matter, with an antiseptic solution or sterile water; if dirty, with soap and water, followed by plentiful irrigation with an antiseptic solution. Every particle of foreign matter must be picked away before a wound is closed, often a tedious process. If the pain is severe or the process protracted, it is sometimes necessary to place the patient under an anesthetic.

As soon as a wound is cleansed it is protected by a sterile dressing.

Accidental wounds are rarely clean and frequently complicated by bruising, laceration, or extensive inflammation. In this condition the dressing usually takes the form of an antiseptic compress, changed at regular intervals or kept moist by some device. An ordinary method is as follows: The wound is covered with several pieces of gauze, wet with the antiseptic preferred, and kept in place by a light bandage. The member is laid on a pillow covered with a piece of rubber sheeting. A douche can filled with the antiseptic solution, to which is attached a length of rubber tubing terminating in a glass pipet, is hung above the bed at a convenient point, so that the pipet drips directly on to the dressing. By this method the frequent changing of the compress is avoided.

REPAIR OF THE WOUND

In an incised wound surfaces are brought together and kept in apposition usually by sutures, or in minor injuries by strips of adhesive plaster. In choosing the needle, where stitches are to be introduced deep into the tissues, as in large fleshy wounds, a needle in which part of the blade is sharp is often preferred. It passes quickly and inflicts less pain. Where the tissues are delicate and easily torn, as in wounds of the face or mucous membrane, such needles inflict injury, and one rounded like the ordinary sewing needle is used. Care must be taken that the needles are sharp or much pain is caused. The sutures must be a convenient length to tie in a surgical knot after they are in place. They must be tied sufficiently tight to keep the edges of the wound in apposition, but not so tight as to pucker the wound.

Before putting in the stitches the edges of the wound must be nicely adjusted or unsightly scarring will result. The stitches themselves cause scarring, and are, therefore, not left in place longer than necessary. Superficial stitches about the face of the wound, thoroughly clean and kept strictly sterile, may often be removed as early as the fourth day. For deep wounds nine days are usually allowed to elapse. If sutures are removed too soon, the edges may gape and primary union fail to take place. If there is much local inflammation, the tissues between the stitches become swollen and tense. To relieve the tension, one or more of the stitches may be removed. Local inflammation may frequently be the result of rough handling of the tissues or of imperfect cleansing. It is often the first sign of infection of a wound.

To remove a stitch, a pair of sharp-pointed scissors and a pair of forceps are used. The stitch is divided close to the tissue. The long end with the knot is then seized with the forceps and gently and quickly pulled, following the direction of the curve made by the stitch. If the scar does not appear perfectly strong, strips of plaster should replace the suture for a few days.

Strips of plaster should be cut narrow and cross the wound from either side, keeping a space between each pair, so that the incision is not entirely covered. Before

applying, the edges of the wound should be held together by gentle pressure of the tissues on either side toward the wound.

If a wound is perfectly clean and the tissues are not bruised, the closing is complete. In the contrary condition some inflammation will take place and discharge will form, which must be allowed to escape. The discharge may be an exudation of blood or serum, or, if the wound is infected, may contain pus. To provide for such discharge an opening is left at the lower end of a wound in which is inserted a *drain*, which may consist of a straight piece of sterile gauze, a few strands of silk or horsehair, or similar substances, or a short length of rubber tubing. (See p. 563.) The drain at first should reach to the bottom of the wound and be gradually shortened as healing takes place. When the discharge subsides, it is removed altogether.

Sutured wounds are protected by a sterile dressing, and usually do not require dressing until the stitches are removed. If drainage has been necessary, they are dressed more frequently—daily or every second day for fresh wounds and usually at longer intervals for chronic varieties.

The temperature chart is a guide for the necessity of dressing. A rise of temperature, especially if preceded by shivering or chilly sensations, frequently indicates local inflammation or the formation of pus. The wound is then examined and redressed.

In both incised and in lacerated wounds the possibility of separation of the tendons must be remembered before the wound is closed. This is particularly liable to happen in injuries to the wrist or hand. The condition is demonstrated by inability to move the wrist or the fingers. If the ends of a divided tendon are exposed, they should be seized at once by whoever is first present, and transfixed by a needle or piece of sterile silk. Owing to the muscular contraction, they become readily withdrawn into the tissues and are often extremely difficult to find later. When several tendons are divided, it is obviously imperative that the right ends should be sewn together. The operation is generally long and tedious.

A **lacerated wound** is treated in the same way as an

incised wound, whenever possible. Provided the wound has been perfectly cleansed and kept strictly sterile, and that the surrounding tissues are not greatly bruised, the results are often extremely good. Wet dressings are usually preferred. Where the laceration is extensive and the local bruising severe, the wound is left altogether open or only partially closed, allowing for drainage. In many cases sloughing takes place, or the wound becomes infected, usually from foreign matter at the time of injury. In such conditions the wound is frequently treated by constant irrigation, or the part is immersed in a local antiseptic bath (Chap. II).

In a **contused wound** the treatment depends on the extent of injury. If the bruising is slight, cold compresses may be used; if extensive, hot antiseptic compresses are preferred, as heat, by bringing a large supply of blood to the part, tends to restore vitality and promotes the absorption of inflammatory products. Contused wounds also are very liable to infection. When the injury is extensive, they may be followed by sloughing or even, in severe cases, by gangrene.

The treatment of a **punctured wound** is guided by the history of the injury. In all cases search should be made for fragments of the instrument that has inflicted the wound. If there is a possibility of dirt having been introduced into the wound at the time of the injury, as from the soil, the clothing, or even the skin of the patient, the treatment usually is to convert the punctured wound into an open one, thoroughly cleanse the part with an antiseptic, and provide for drainage.

The reason for this should be understood. The complication most to be dreaded in the healing of wounds is *tetanus*. The tetanus germ, we remember, is anaërobic, that is to say, develops in the *absence of air*. The recesses of a punctured wound of which the opening is sealed by a sterile dressing forms an ideal medium for its cultivation. The danger of its development is lessened if the wound is freely exposed. The tetanus germ has been known to develop in a punctured wound so small and apparently so unimportant as that caused by a hat-pin driven into the scalp in a fall on the head.

Even where the wound is clean, a wet dressing is usually preferred to a dry one, as helping to dislodge minute particles of foreign matter that may have been overlooked.

A **gunshot wound** has frequently the characteristics of both a lacerated and contused wound. In a penetrating gunshot wound vital organs may be injured and important structures badly torn. Small gunshot wounds, such as those inflicted by toy pistols or fireworks, are liable to be followed by *tetanus* from the lodgment of pieces of soiled rags, etc., in the wound. They are generally laid open, cleansed, and dressed with a wet antiseptic dressing. The administration of tetanus antitoxin serum is generally advised.

COMPLICATIONS OF WOUNDS

The healing of wounds may be complicated by inflammation, local infection, the formation of abscesses, sloughs, gangrene, or emboli; and by special infections, of which the most important are erysipelas, general septicemia, tetanus, and scarlet fever. A condition developing from a wound is described as *traumatic.*

Inflammation.—Except in the case of clean, incised wounds, wounds caused by accident are almost invariably followed by a certain amount of inflammation. The phenomenon of inflammation, its symptoms and treatment, are described in Chapter III. Inflammation in wounded tissue is treated on the same general principles, *i. e.*, rest to the part, and, unless the inflammation is slight, the local application of heat or cold, in the form of stupes or compresses, constant local irrigation, or the local antiseptic bath. In wounds of the extremities the part is kept more especially at rest by the application of suitable splints.

Inflamed tissues offer very reduced resistance to bacterial invasion; antiseptics, for this reason, are generally used in the dressing and treatment of accidental wounds, although the tendency of modern aseptic technic is to discard their use as far as possible.

Infection.—In spite of strict technic and careful cleansing, local infection by one of the pus-producing germs, commonly the *staphylococcus pyogenes aureus* (p.

379), is a common complication in the healing of wounds of accidental origin. The most prominent general symptoms are shivering, rise of temperature, and malaise; locally there are inflammation, tension, and the formation of pus. The local treatment lies in the use of antiseptics and the encouragement of drainage; the hot antiseptic compress is a common form of treatment combined with regular irrigation with an antiseptic solution. Heat, favoring suppuration, may, however, be contraindicated in some conditions. If pus forms, the wound is opened up, the abscess cavity evacuated, and some form of drain introduced. Until the symptoms of acute infection have subsided, the wound is usually dressed at frequent intervals.

It must always be remembered that an infected wound may infect others. Strict technic must be observed in changing the dressings. The dressing should be reserved scrupulously to the last, and no other wound should be exposed during the dressing of an infected one. Whereever practical, infected wounds are not nursed in the same ward as clean operation cases.

The most virulent form of local infection is by the *bacillus pyocyaneus*, a pus-producing germ belonging to the bacillus group (p. 358). The discharge has a blue-green or blue color, and is commonly known as *blue pus*. The condition is highly infectious. Wounds with this complication are usually isolated from the general surgical wards, and those concerned in dressing the wound or in nursing the patient are forbidden to enter the operating-rooms or "clean" wards. Blue-pus infection is not infrequently followed by general septicemia. The treatment is the same as in other local infections, but special attention is given to building up the patient's strength by generous diet, good hygiene, and, usually, the use of a stimulant.

Inflammation spreading to the adjacent cellular tissue is known as *cellulitis*, and, in severe cases, closely resembles erysipelas. The onset is usually less abrupt, the redness not so acutely defined, and the physical symptoms much less severe. Except as complicated by infectious processes, simple cellulitis is not considered contagious. The usual treatment for inflamed conditions is followed; if the tissues

are infiltrated with infectious processes, free incision is usually performed, and drainage established; but the treatment is obviously guided by the structures involved.

Slough.—A slough is a piece of dead tissue in living tissue; in other words, a strictly localized gangrene. The word is used in connection only with soft tissues. A dead piece of *bony* tissue is called a *sequestrum.* Sloughs occur when, for some reason, there is not sufficient blood-supply to enable the wounded tissue to recover its vitality. The blood-supply may be cut off by the severing of important vessels, by the extensive crushing of the tissues, or by the prolonged application of cold to a large contused area. Lacerated or contused wounds and burns are most prone to the formation of sloughs. When a slough has formed, it is not reabsorbed, but must be thrown off. Nature accomplishes this by a local acute inflammation between the living and the dead tissue. The process is helped by hot fomentations, but as they tend to increase inflammation and favor suppuration, they are not always considered advisable.

Sloughs should not be pulled away, or hemorrhage may result. Portions already separated are generally carefully cut away from the remaining parts. On separating, a slough leaves an exposed surface, which heals by granulation. If the cavity is deep, it is usually packed with gauze, generally saturated with an antiseptic or a stimulant preparation. The wound is dressed daily, and thoroughly irrigated with an antiseptic solution. Another method is to dust the cavity with a sterile antiseptic powder and pack it with dry gauze. The granulations are apt to be indolent. The local suppuration has a tendency to spread along the connective tissue, causing the small accumulations of pus known as pockets, and the formation of small sinuses. A *sinus* is a passage leading from the skin surface to a pus-cavity. A similar passage opening on a mucous membrane is called a *fistula.*

Gangrene, the total death of a part, involves both soft and bony tissues and occurs most usually in the lower extremities. It is most commonly associated with conditions in which the blood-supply is deficient, especially diabetes and senility, when a small injury may be followed

by gangrene. In wounds it is caused locally by the cutting off of the blood-supply, as by—(1) the division of a large blood-vessel, such as the femoral artery; (2) strangulation, accidental, or from prolonged application of a tourniquet; (3) embolism, the blocking of a vessel by a blood-clot.

Gangrene may be *dry* or *moist*. When the immediate result of a wound, it is distinguished as *traumatic gangrene*. A black local discoloration is first noticed, which spreads slowly or rapidly, according to the physical condition. As decomposition progresses the odor is very offensive. In time a line of demarcation forms, as in the separation of sloughs, and the part is thrown off, leaving a discharging unhealthy surface. In the aged or feeble death frequently takes place before separation occurs.

The question of operation is decided by many conditions. Unless the gangrene shows signs of spreading very rapidly, it is not usual to amputate until the line of demarcation has formed—a process often requiring many months.

In the local treatment the extremity is elevated and wrapped closely in many layers of warm absorbent cotton. If the gangrene is dry, the dressings are usually kept dry, and the part dusted with an antiseptic powder. In moist gangrene applications of warm or hot antiseptic compresses are frequently used (boric, 2 per cent., or bichlorid, 1 : 5000), and changed every four or six hours. In dressing, care must be taken that the surface is not chilled by exposure to cold air. The limb above the part is kept also closely wrapped, and should receive regular rubbing in order to promote a good circulation.

The general treatment is directed toward supporting the health with a nourishing diet and good hygiene. The skin requires special care, as bed-sores form easily. Tonics and alcoholic stimulants are generally prescribed. Heavy patients are nursed most comfortably on an air- or water-bed.

Embolism is the blocking of a blood-vessel by a clot of blood. A clot that is set free in the circulation and finally lodges in a vessel is called an embolus; a clot remaining where it forms, and causing plugging of the vessel, is called a *thrombus*, and the condition is known as *thrombosis*. Normal blood does not clot in an unimpaired vessel. If, however, the walls of a vessel, or of the lining of the valves

of the heart, are roughened by inflammation or injury, fibrin tends to become deposited, and a clot is formed, which is readily swept into the blood-stream. Thrombosis is the result of a diseased or inflamed condition of a blood-vessel or of a valve of the heart. Common causes are phlebitis, arterial degeneration, infection, endocarditis, and aneurysm. The symptoms develop gradually, and are modified by the locality in which the thrombosis occurs.

Thrombosis of a vessel in an extremity is accompanied by local swelling, with tenderness along the line of the vessel. Some physical disturbance is also present. An embolus is caused by—(1) Separation of a thrombus; (2) laceration of vessels, as by a fracture or other injuries; (3) use of styptics in the treatment of hemorrhage from large vessels, for example, the uterine sinuses.

An embolus travels along the circulation until it arrives at a blood-vessel not large enough to allow of its passage. Lodging in a cerebral vessel, in one of the large vessels leading to or from the lungs, or in the heart itself, grave physical symptoms develop abruptly.

In cerebral embolism the symptoms are those of apoplexy, and are more or less severe, according to the vessel affected. There may be hemiplegia or general paralysis. Recovery is rare. In pulmonary embolism the prominent symptoms are sudden dyspnea, cyanosis, and loss of consciousness. Death follows quickly in a few hours at most. In cardiac embolism the symptoms are the same, but death occurs almost instantaneously from arrest of the function of the heart.

Traumatic embolism is not a common complication in the healing of wounds.

Keloid.—A keloid is a tumor occurring on the surface of a scar after healing is complete, due to an overactivity of the connective tissue. It is usually removed by operation, but frequently recurs. The colored races are more prone to keloid than the white.

GENERAL INFECTIONS DEVELOPING FROM WOUNDS

General septicemia following accidental wounds, the result of the absorption of septic processes into the general system, is in no respect different from the same condition

following an operation, the symptoms and treatment of which have been already described.

Erysipelas is an infection due to a micro-organism of the streptococcus variety, which invades the system only through an abrasion of the skin or mucous membrane. The prominent characteristic of erysipelas is a crimson rash, with well-defined edges, occurring in the vicinity of a wound, accompanied by swelling and induration of the tissues (p. 716). The temperature rises abruptly, often to 104° F. or over; the patient shows the usual physical accompaniments of fever (p. 708), and is generally delirious. The rash fades after four or five days, and is followed by desquamation. If there are no local conditions to keep the temperature up, it usually falls about the end of a week, and frequently by crisis, after which convalescence is rapid.

As the organism is introduced through the abraded surface, a case of erysipelas is a menace to any wound with which it may be in direct or indirect contact (through nurses, dressers, etc.). (See Chap. XIV). An erysipelas case is usually strictly isolated from other surgical cases

The treatment comprises a liberal liquid diet, and, as in all conditions of general sepsis, stimulants—whisky or brandy—are given in considerable quantities; usually some form of iron is also prescribed, and the system is thoroughly purged.

Local treatment consists in keeping the affected area covered, and such applications as ichthyol ointment, carbolic ointment, tincture of iodin, etc.

True erysipelas is a comparatively rare complication in the healing of wounds. The so-called *idiopathic* variety occurs on the face, usually beginning at the nose and spreading to the hair-line. Although known as *idiopathic* or spontaneous (in contradistinction to *traumatic*), it is considered that the germ usually gains entrance through some small abrasion, probably on the mucous membrane of the nose. Burns, where the surface is extensively denuded, are particularly liable to erysipelas infection.

Scarlet Fever.—Traumatic scarlet fever is not in any respect different from the idiopathic variety. The attack

is generally a mild one, but is capable of infecting a third person with a severer form. It is often impossible to trace the origin of the infection. Patients freshly operated on and women during the puerperium are specially liable to scarlet fever infection. A nurse who has been in contact with scarlet fever even indirectly should not undertake either an operation case or a maternity case without first notifying the surgeon of the fact. The usual precautions for isolation must be observed.

Tetanus.—The tetanus germ is introduced by direct inoculation, usually at the time of an injury. Wounds contaminated by soil are especially liable to be infected (p. 417). The symptoms may develop shortly after an operation or not for a week or more. One of the early symptoms is a stiffness about the jaws, the first sign of which must be promptly reported. The chief symptoms of tetanus are the characteristic convulsions (p. 669), accompanied by irregular fever and great prostration.

The present treatment is to give tetanus antitoxin serum at as early a period as possible; the wound is freely opened, as described above. The patient is isolated, and the room kept as absolutely quiet as possible, since the slightest noise brings on a convulsion. A liberal diet is necessary; if the jaw is locked, the patient is usually fed by the nasal tube. Sedatives, such as bromid and chloral, are usually ordered. The tetanus bacillus may be present in the wound secretions. At the present day such cases are usually isolated from other surgical cases.

A severe case of tetanus is very frequently fatal. As a rule, if there is any chance that a wound has been contaminated by soil, tetanus antitoxin is administered without waiting for symptoms to develop.

In the late war every wounded soldier in the British Army (presumably also in others) received an injection of tetanus antitoxin serum on the field, with the result that this most fatal complication was practically non-existant. In all previous wars death from lockjaw was the fate of thousands of wounded. Perhaps in no other way has modern scientific investigation shown itself so directly beneficial to life.

CHAPTER XIX

NURSING IN ACCIDENTS AND EMERGENCIES (Continued)

Burns and Scalds—Immediate Treatment: Of the Eye; the Throat; Dressings—Stages—Physical Treatment—Complications—Burns by Lightning, Electricity—Bites—Stings—Frost-bite—Boils—Stye—Carbuncle—Whitlow—Convulsions: Tonic, Clonic, Epileptiform, Tetanic—Causes—General Treatment—Points to Observe: in Convulsions; in Epilepsy; in Alcoholism; in Uremia; in Children; in Tetanus; in Strychnin-poisoning; in Hysteria—Foreign Bodies: Eye, Ear, Nose, Throat, Esophagus, Larynx—Artificial Respiration: Sylvester Method; Marshall Hall Method; Drowning; Asphyxia of the New-born — Fainting — Concussion — Heat Exhaustion — Heat Stroke.

BURNS AND SCALDS

Burns and scalds are caused by the effect on the soft tissues of direct heat. Burns are caused by dry heat—fire, electricity, red-hot substances, or corrosives; scalds are the result of moist heat, steam, or very hot fluids. In burns or scalds three degrees of injury are recognized: (1) Reddening of the skin; (2) destruction of the true skin and the formation of blisters; (3) injury to the deeper tissues. Acute pain is a prominent symptom, especially in burns of the first and second degrees.

A scald is usually of the first or second degree; serious scalding is often the effect of a boiler explosion, frequently involving an extensive portion of the body, and generally including the face.

The symptoms and treatment of burns and scalds are the same and will be considered together.

In all such accidents the physical condition is to be considered as well as the local. *Of the two, the physical condition is the more immediately important.*

The extent of a burn is a more serious condition than the depth. A superficial burn of large area is more fatal to life than a deep burn of localized extent. A fatal result

is looked for if *two-thirds* of the body are involved, even if only by burns of the first degree.

Unless a burn is very slight or very severe, it is not possible, at the time of the accident, to estimate the severity of the injury or to determine the degree to which the burn may belong. Nurses should be very careful in concluding that a burn is slight.

Immediate Local Treatment (Scalds are Included under Burns).—Burns of the first and second degree cause intense local pain, which is most quickly relieved by the application of a cold wet dressing. Plain sterile water may be used, or a solution of boric acid (2 per cent.) or a weak solution of bicarbonate of soda. Contact with the air increases the pain; the burn should, therefore, be covered quickly. The bandage must be applied lightly, as some swelling is sure to follow, and it is not possible at the time to gage the extent of the injury. Any clothing must be gently removed.

Instead of applying a cold wet dressing, the surface of the wound may be freely dusted with flour or bicarbonate of soda (baking-powder), and covered with absorbent cotton. If vesicles form and break, however, dry substances are apt to cake and become difficult to remove. The burn may also be dressed with oil or an ointment spread on gauze or old soft muslin. Such a dressing relieves pain by effectually excluding the air, but is apt to become hot and uncomfortable. Any simple oil or ointment that is available serves for a first dressing; butter or lard will also answer the purpose. Carron oil, an equal mixture of lime-water and olive or cotton-seed oil, is frequently, in homes, kept for such emergencies, but is considered a dressing difficult to keep surgically "clean."

If a burn is caused by corrosives, the injured surface should first be washed with plenty of cold water, in order to get rid of the irritating substance. An antidote is used if one is available. For acid corrosives, weak ammonia and water or a solution of bicarbonate of soda may be used; for alkaline corrosives, vinegar and water, lemon-juice and water, or a dilute acid solution. Boric acid is usually available. The antidote to carbolic acid is alcohol;

burns caused by carbolic acid are washed and dressed with alcohol; oil applications in this condition are especially to be avoided (p. 340), since oil helps in the absorption of carbolic acid.

In burns of the second degree the first stage of congestion is followed in a few hours by the formation of vesicles. When fully risen, each blister is snipped at its most dependent part with a sharp-pointed pair of scissors and gently pressed to allow the fluid to escape. The cuticle is not cut away: it serves as a natural protection to the denuded surface. For the simple dressing, one containing a mild non-irritant antiseptic is then substituted.

Burns of the third degree are always serious, and if involving more than two-thirds of the body, they are commonly fatal in a few hours. Other cases linger a few days. If less extensive, recovery may take place, with a long and tedious convalescence, or the patient may succumb later to one or other of the complications associated with burns.

Such burns are frequently the result of the clothes catching fire. The first examinations should ascertain that no smouldering is still going on. The charred remains of the clothes must be removed. If the physical condition permits, this is frequently done under ether; the burns may then be sprayed with peroxid of hydrogen, and irrigated with warm boric solution. A dressing is then applied—either an ointment dressing or a wet dressing. In many cases of extensive injury the burns are treated without local dressing. Two methods are used—the "open treatment" and immersion.

In the **open treatment** of burns the patient is laid between sterile sheets and the burns are freely dusted with a sterile dusting-powder, usually stearate of zinc. A bed-cradle is necessary to keep the bed-clothes from pressing on the burns. The air, which by this method is not excluded, must be kept at an even temperature. Where the trunk of the body is involved, the temperature should not be less than 80° F. This temperature may be maintained by hot-water cans, bags, etc., or an electric light, where one is available, may be tied to the bed-cradle and

the outer air carefully excluded by the bed-coverings. The patient's body then lies in a closed cabinet of warm air. A light of 16 candle-power is generally sufficient. (See p. 69.)

Immersion may be local if a limb only is injured (see Local Baths, Chap. II), or the entire body may be placed in a tub sufficiently long for the patient to lie comfortably extended. To the water either boric acid or bicarbonate of soda is usually added. (See Baths.) The water must be changed at least once a day. During the process the patient is wrapped in a clean sterile sheet, the burns being meanwhile dusted with a sterile dusting-powder. The water excludes currents of air, keeps the surfaces clean, maintains the body temperature, and reduces the general restlessness. With children, total immersion is especially successful.

Burns of the eye are usually caused by a corrosive or by an atom of red-hot metal. Treatment must be prompt. In burning by a corrosive the lids should be held open and the eye freely irrigated with cold or tepid water. The stream should be forcible, in order quickly to wash away every atom of the irritant. The eye may be held directly under a faucet if no other means are available. A little vaselin or a few drops of castor oil may then be put between the lids. Cold or iced compresses should be continuously applied until surgical aid can be obtained, and the patient kept lying down in a room with the light shaded. If, in order to act promptly, unsterile water has been used, the eye should, as soon as possible, be douched with warm boric-acid solution (2 per cent.).

In burns to the eye from a red-hot metal not a moment must be lost in obtaining surgical assistance. Cold compresses may be applied in the mean time, but no other treatment attempted. Unskilful attempts to remove the foreign body may involve extensive injury to the tissues and result in loss of the eye.

Burns of the mucous membrane of the throat are common in children from attempting to drink scalding water; they are also caused by drinking corrosive poisons. If severe, death usually results from shock. Where treat-

ment is possible, the patient is nursed in a warm atmosphere, kept moist by a steam kettle to which some respiratory disinfectant, such as benzoin or eucalyptus, is added. Feeding is administered by rectum. Stimulation is usually given by hypodermic. A throat spray, usually of equal parts of peroxid of hydrogen and lime-water, or of chlorate of potash (grs. v to the ounce), is used every two or three hours. If swallowing is possible, small quantities of milk, bland drinks, or sweet oil are given repeatedly by mouth, for the local action, as well as for the purpose of nutrition. The pain of swallowing may be lessened by spraying the throat with cocain. Where the swelling is great, tracheotomy may be necessary. The indications for tracheotomy or intubation are increased dyspnea and cyanosis.

Dressings.—The first dressing of a burn is generally left on for twenty-four hours. On removal, any blisters are snipped, and a dressing containing a mild antiseptic is substituted. Vaselin, to which is added boric acid or salol (of either, 20 grains to the ounce), is commonly used if an ointment dressing is preferred. More commonly at present burns are dressed with wet dressings. Warm normal salt solution is generally preferred. A strong antiseptic is not advisable on account of the risk of absorption from an extensive surface. To prevent the dressing sticking, the surface is first protected with strips of gutta-percha tissue. The strips are kept in a solution of bichlorid of mercury, 1 : 2000, which is washed off by soaking the strips in salt solution before applying. The dressing is remoistened before it gets dry.

Dressings are usually changed daily, and must be done with strict aseptic precautions. From the nature of the injury a burn is, in the first instance, an aseptic wound; it can, however, readily become infected. If a dressing sticks, it must be removed by soaking. Pulling not only causes great pain, but may destroy the young granulations or cause extensive bleeding.

Burns treated by the open method become covered with scabs composed of dry discharges. When granulation is established, it is usual to remove the scabs, a small portion daily, with a pair of sterile forceps.

In deep burns of the third degree the tissues are devitalized. In this condition, when the injury is local, hot fomentations, usually of boric acid, are frequently used, until the surface begins to discharge freely.

The wound caused by a burn runs a definite course, with four well-marked stages: (1) Congestion; (2) vesication; (3) suppuration; (4) granulation.

The dressing of burns in the first two stages is as already given. In the third stage the surface of the burns is covered with a copious discharge, which becomes very offensive if allowed to accumulate. The daily dressing is then accompanied by a free irrigation with a warm antiseptic solution, commonly boric acid. At this stage picric acid is frequently substituted, both as a wet dressing and for irrigation (picric acid, 40 grains; alcohol, $\frac{1}{2}$ ounce; cold water, 1 pint). It is antiseptic and astringent, and promotes cleansing of the wound and healing. As the picric stains linen yellow, old worn sheets should be used on the bed and old night-shirts.

During the stage of suppuration sloughs become separated and are thrown off. They should be cut away when possible. (See Sloughs.) If the sloughs are deep, their separation may cause secondary hemorrhage.

As the suppuration lessens the wounds should present a surface of healthy granulations. As in general wounds, indolent granulations require stimulating treatment, and redundant granulations are kept down by an application of silver stick or blue stone. The healing of extensive surfaces is slow and tedious. When the period of suppuration is passed and the surface is clean, the healing process is frequently hastened by skin-grafting.

As burns heal, the formation of the scar tissue is liable to cause contraction. If the injury is near a joint, this may result in permanent crippling. The danger is lessened by the use of suitable splints, extension, the early practice of passive movements, and by encouraging the use of the affected limb in spite of the pain caused by the first efforts to do so.

Physical Treatment.—As far as life is concerned, the physical treatment in an accident by burning outweighs

in importance the local treatment. The physical effects of a serious burn are, at first, shock, extreme restlessness, and excessive thirst. Shock may not be apparent at first, but should always be apprehended, even when the injury appears comparatively slight, and especially so if the patient is a child. Frequently the patient seems to progress favorably to a certain point, and then suddenly sinks. Death from shock occurs within twenty-four hours of the accident. (See Shock.)

The immediate physical treatment is rest in bed and quiet, external warmth, and plenty of water to drink. A stimulant is generally given, either alcohol or strychnin, and in extensive burns morphin is usually necessary. With children opium is always given with great caution. Usually paregoric is the preparation preferred. A purge, generally calomel, is commonly ordered.

If the patient lives, the period of shock is followed by a period of reaction. The temperature, subnormal at first, rises, probably above 103° F.; there are continued fever, delirium, great restlessness, and, generally, vomiting and diarrhea; convulsions may be present, especially with children. The condition may pass into fatal coma, or death may take place from exhaustion or other complications. The urine is scanty or suppressed. During this stage the patient is kept quiet, with the light shaded; the diet is liquid, and consists especially of milk, which may be diluted with lime-water or Vichy, and albumin-water. For the thirst, lemonade to which is added cream of tartar, $\frac{1}{2}$ ounce to a pint (Imperial drink), is given freely. Besides relieving the thirst, the cream of tartar assists elimination and stimulates the activity of the kidneys. Bromid is usually given, and the bowels are purged with calomel or castor oil. If persistent, the vomiting may be relieved by hot applications to the epigastrium. Diarrhea is usually treated with astringents or opium. When the vomiting and diarrhea cease, beef-tea, broths, or beef-juice is added to the diet. As the condition improves, semisolids and, finally, solids are given. During the periods of suppuration and granulation the diet should be highly nourishing. Fresh air,

good hygiene, and cheerful surroundings are important. Tonics, especially iron or bitters, to stimulate the appetite, are generally ordered.

Complications.—The local complications of a burn are, as mentioned above, extensive sloughing, secondary hemorrhage, and permanent contraction of the part; unsightly scarring may be added. Embolism may occur, especially where there has been extensive sloughing or secondary hemorrhage. As in other wounds, a burn may be the medium of a general infection.

Patients suffering from burns are peculiarly liable to infection by erysipelas or by scarlet fever. No one in any way in contact with such cases should be admitted near a case of burns. Shivering, an abrupt rise of temperature, a sudden attack of vomiting, and, in children, convulsions, are symptoms to be regarded with suspicion. Erysipelas is especially likely to occur where the face is the seat of injury.

Septic absorption is liable to occur during the period of suppuration. The general condition is usually treated by drugs that promote elimination and by general stimulation.

Other complications to be apprehended in burns of any extent are congestion and inflammation of the internal organs, bronchitis, pneumonia, nephritis, and intestinal inflammations. Bronchitis and pneumonia may especially be looked for after scalds of the mucous membrane of the throat. Nephritis and intestinal inflammation are most common in extensive burns of the trunk. In a large measure the condition is caused by the extra work thrown upon the organs of elimination by destruction of a large area of the skin. Other causes are septic absorption and the direct local effect of the burn, which acts as a powerful counter-irritant, and, it is considered, probably causes important changes in the underlying structures.

Burns about the abdomen are generally associated with inflammation of the intestines and frequently with ulceration, especially of the duodenum. Death may occur from rupture of a duodenal ulcer or from hemorrhage. The stools should be watched for traces of blood. As the lesion

is high, the stools will have a tarry appearance. Localized abdominal pain, acute or persistent, and distention are important symptoms of this condition. The treatment is the same as in any other case of intestinal hemorrhage (p. 601). Nephritis is one of the most common complications of extensive burns. It is characterized by headache, albuminuria with scanty urine, and puffiness of the face and feet. In severe cases hematuria may be present. The diet is usually restricted entirely to milk as long as albuminuria persists. Elimination is aided by purgatives and diuretics, water or Imperial drink is given freely.

Burns by Lightning.—Burns due to lightning, electricity, or to prolonged exposure to the x-rays may also be met with. A burn by *lightning* is branched like a flash of forked lightning. The patient is severely shocked, and frequently unconscious. On recovery, loss of sensation and temporary local paralysis are commonly present; there are frequently disturbances of vision, and the patient may remain permanently blind.

The local treatment is the same as for burns from other causes. The tissues are necrosed and healing is slow.

In treating the condition of shock electricity must not be used.

Burns by electricity may be slight or severe. The shock is frequently fatal. A severe burn is practically the same as a burn by lightning.

In an accident by electricity it is of immediate importance to break the electric circuit. If an interruption is at hand, this is easily done, or if the wire is insulated at any available point, it can be removed; if not, the patient must be pulled away.

Until the circuit is broken, any one touching the person struck with bare hands will also be shocked. Silk and wool are non-conductors if perfectly dry. The hands may be closely wrapped with anything available of these materials; the clothes of the victim may then be grasped, and he can be pulled away, thus breaking the circuit. If the available force is not sufficient to move him, a thickly folded blanket should be pushed under him, using which as a pad he may be raised from contact with the earth, which

is the other pole of the circuit, and moved to a place of safety. The patient is unconscious and in an extremely critical condition.

The treatment must be prompt. The clothes are loosened, fresh air is admitted, external heat and stimulation of the circulation by friction, etc., applied. Artificial respiration is usually necessary, and should be continued as long as the heart can be felt to beat. Cardiac stimulants may be given by hypodermic. Once respiration is restored, the subsequent treatment is the same as for any condition of shock, avoiding only all use of electricity.

BITES AND STINGS

The **bite of an animal** inflicts a *punctured* wound, which, in the majority of cases, is also *lacerated*. The wounds are usually slow in healing and readily become infected. Superficial wounds are usually dressed with hot antiseptic compresses. Where the puncture is deep or there is dirt in the wound, the usual treatment is to open up the wound freely. Strong astringents or the actual cautery should not be applied unless there is actually hemorrhage to be controlled.

Extensive bites, where the tissues are much lacerated, are commonly accompanied by extreme shock. The possibility of shock in any case must be borne in mind.

A **bite by a rabid animal** is rare, and cases so reported are frequently not authentic. Many dogs in hot weather suffer from heat-stroke. In this condition they appear mad, and if molested are apt to bite. Every effort should be made to keep the dog alive and under observation—expert, if possible. If the dog is proved not to be rabid, much needless anxiety is spared the victim.

Until recently the only treatment advised for such wounds was instant cauterization. It is now considered that, by thus sealing the tissues, absorption of the poison is furthered. The present treatment consists in laying open the wound, thoroughly cleansing the part with antiseptics, and the application of hot antiseptic compresses. If the dog is known to be rabid, the patient is usually advised to undergo the Pasteur treatment at once.

Snake-bite.—The action of the venom of a snake-bite on the system is similar to the action of bacterial toxins. The poison acts directly on the central nervous system, producing profound prostration, and sometimes fatal collapse. The venom also attacks the blood-cells and destroys the coagulability of the blood. Extravasations of blood causing a petechial rash are common.

The bite of even the most venomous snake is not now considered necessarily fatal, provided treatment can be prompt. The local treatment usually advised is to apply a tourniquet above the bite (if in an extremity), with the object of preventing the poison from reaching the general circulation, and to cover the small wound with a wet dressing, in order to encourage bleeding. Cupping is advocated if it can be done immediately. Cauterization is not considered advisable.

The physical treatment consists in rest, external heat, and the free use of stimulants. Doctors advise strychnin or atropin in preference to the alcoholic stimulants; they are, however, frequently not at hand. The patient should be reassured and encouraged to a hopeful view of his condition.

Stings.—In a sting we have a minute puncture into which a poison has been introduced, which has a local irritant action. The poisons of insects are acid; the irritation is, therefore, best relieved by an alkaline application, such as ammonia, soda, common soap, or laundry blue, all of which are usually available. An acid, such as carbolic acid, also relieves irritation by causing a superficial anesthesia.

A bee or wasp may leave its sting in the wound. This should first be removed by pressing some hollow round object, such as an old-fashioned key, firmly on the tissue immediately round the mark of the bite. The area, which is often considerably swollen and painful, may then be bathed with hot water and ammonia, and finally dressed with a cold compress of dilute ammonia water or other alkaline preparation. If a patient has been attacked by a swarm of bees, he is probably in a highly nervous condition, and may be considerably shocked. Bromid, bromid and

chloral, or a small dose of morphin is often necessary. The injured part may be covered with hot compresses containing ammonia, heat soothing pain more effectively than cold.

FROST-BITE AND EXPOSURE

A frost-bite is the local result of prolonged exposure of the body to extreme cold, most commonly occurring on the more exposed parts of the body, the fingers and toes, the ears, nose, and the skin over the cheek bones. The extreme cold causes contraction of the superficial blood-vessels; if the circulation in the part is not maintained, the blood-supply is entirely cut off, resulting in the death of the part. In mild cases a slough is formed; in more severe cases, gangrene results.

If seen early, the part attacked has a blanched appearance, and should be briskly rubbed with a lump of snow or a cloth wrung out of ice-cold water, taking care not to bring the sufferer into a warmer atmosphere until the normal color is restored. In severe cases, involving prolonged general *exposure*, the patient may be in a comatose condition. The first treatment is then to restore the circulation of the body. The patient is laid in a room of low temperature (about 50° F.), and the whole body briskly rubbed with the hands. As the warmth of the body returns the temperature of the room is gradually raised and the body is covered with warm blankets. Hot drinks and alcoholic stimulants may then be given. If the patient remains unconscious, hot rectal irrigation with normal salt solution, coffee and brandy enemata, and cardiac stimulants by hypodermic are given, with the usual treatment for shock.

When the circulation is restored, the local injuries are dressed. An anodyne, such as tincture of opium or opium liniment, is frequently applied first, and the parts are wrapped in absorbent cotton. Later, when sloughing occurs, hot antiseptic applications may be used to hasten the separation of the sloughs and lessen the risk of septic absorption. Should gangrene result, the part is enveloped in cotton until separation takes place, and the surrounding

tissues regularly rubbed and protected from changes of atmospheric temperature. In some cases, as, for example, where the whole foot is involved, amputation becomes necessary.

In the after-treatment the general health must be built up by liberal diet and the use of stimulants and tonics.

BOILS, STYES, CARBUNCLES, WHITLOW

A **boil** or **furuncle** is an acute local inflammation of a hair-follicle or sebaceous gland, usually due to local infection by a pus-producing organism (Chap. XII). Where suppuration does not occur, the lesion is known as a *blind boil.*

A boil may be an isolated occurrence. More frequently, boils tend to occur in groups and to recur at intervals. The condition is favored by a debilitated state of health, and especially by the presence of chronic debilitating diseases, such as diabetes and nephritis.

Suppuration is hastened by the use of hot compresses or counterirritants, such as ichthyol ointment. As soon as the local abscess has formed, the boil is incised. In the center will be formed a small lump of necrosed tissue. The little cavity is irrigated, lightly packed, and dressed with a simple aseptic dressing or some astringent ointment. The application of a caustic, such as crude carbolic, to the cavity is sometimes recommended. The surrounding parts should be carefully cleansed with an antiseptic solution, to protect other hair-follicles from infection.

Recurrent boils may be due to the state of health, to infection from the existing boil, owing to scratching or careless dressing, or to lack of cleanliness in the clothing. The care of the general health and the removal of any debilitating cause are important parts of the treatment.

A **stye** is a small furuncle occurring on the margin of an eyelid, involving a hair-follicle. The usual treatment is to apply hot boric compresses until a small point of suppuration is seen round an eyelash; on pulling out the eyelash a channel of escape for the discharge is formed, and, after a few more applications of the hot boric compresses, the inflammation usually subsides.

A **carbuncle** is an acute inflammation attacking the skin and underlying tissues, also due to infection through a hair-follicle by one of the pus-producing organisms. The infection spreads through the subcutaneous tissue, involving a considerable area, and causing numerous local points of suppuration and necrosis. In appearance the skin over the area is red and brawny, and pitted with openings discharging pus. The necrosed areas increase, forming large, offensive sloughs, attended with copious discharge. The condition is accompanied by the physical symptoms of sepsis, attacks of shivering, fever, and great prostration. Patients are usually in middle age, and frequently are sufferers from some chronic debilitating disease, especially diabetes. From a neglected carbuncle general septicemia may result.

The usual sites of a carbuncle are the nape of the neck or the back, between the shoulders; more rarely they occur on the buttocks.

The surgical treatment consists in free cross incision, so as fully to expose the necrosed areas and allow for drainage. The sinuses are usually cureted, or applications of crude carbolic are used. Hot antiseptic compresses are employed to hasten the separation of the sloughs. A thorough dressing is given at least once daily. The area may be syringed with peroxid of hydrogen, and freely irrigated with a mild antiseptic. On account of the extensive surface, strong antiseptics are not used. The deeper pockets and sinuses are lightly packed, and sloughs are cut away as soon as possible. The possibility of hemorrhage on the separation of the slough should not be forgotten, and the means of controlling it kept on hand.

The cure of a carbuncle is long and tedious. The care of the physical condition forms an equally important part of the treatment. Rest in bed, good hygiene, and a liberal, nourishing diet are essential. Stimulants are generally given freely, and tonics, especially iron, arsenic, and quinin. As in all septic conditions, elimination should be active.

A **felon, whitlow,** or **paronychia** is a local infection occurring near or under a nail. It is frequently the result of leaving exposed the small wound caused by a pin-prick.

The inflammation is accompanied by acute pain, owing to the tension caused by the limited area for expansion, due to the proximity of the bone. If not relieved, the infection is liable to spread along the lymphatics and cause painful enlargement of the glands in front of the elbow and in the axilla. Local suppuration usually occurs rapidly.

The usual treatment is to apply hot antiseptic compresses, followed by incision as soon as suppuration has taken place. If the patient can be persuaded to keep the finger in a hot antiseptic bath (carbolic, 1 : 40, or bichlorid of mercury, 1 : 2000), either continually or for a couple of hours at a time, suppuration may frequently be averted.

The incision must be made with the same strict aseptic precautions observed in larger operations. The opening of a small infected area with a non-sterile needle, etc., is a frequent cause of general septic infection. If the discharge is imprisoned by the nail, it becomes necessary to cut away a portion of the nail to allow a channel of escape. It is a painful operation, and is generally done under a local anesthetic, such as freezing the surface with ethyl chlorid.

The small cavity is usually cureted, or, instead, an application of crude carbolic may be preferred, after which a small drain of gauze is inserted and a dressing applied. As from the locality of the wound the smallest tension causes acute pain, a wet dressing is usually preferred, which favors the escape of discharge.

Young nurses often show a disposition toward repeated small infections of this nature. The general health should be attended to, the bowels regulated, the appetite encouraged, and a certain amount of time spent daily in the open air. Tonics, especially the iodid of iron or the elixir of iron, strychnin, and quinin, are frequently prescribed. Nurses should be taught to cover all pricks and scratches at once. The application of a light collodion dressing is sufficient to protect from infection.

If a felon is neglected, the suppuration may spread to the deeper tissues involving the periosteum, and possibly lead to the destruction of a portion of the bone. The whole finger is inflamed and acutely painful. The usual treat-

ment is free and deep incision, without delay. The wound is kept open by a drain of gauze, etc., over which a wet antiseptic dressing is applied. If a sequestrum forms, the wound will not heal until the fragment of bone has separated and been removed. In such a condition the physical symptoms are usually severe. Shivering, fever, and the general disturbances of a septic condition are present. They are treated with free purging, rest in bed, and a liquid diet as long as the fever lasts, after which a liberal diet, the use of tonics, and good hygiene are the general lines of treatment.

CONVULSIONS

By the term *convulsion* is understood a paroxysm in which the voluntary muscles are contracted involuntarily. The convulsion may be *general* or *local;* the muscular contractions *continuous* or *intermittent.*

Continuous contractions are called *tonic;* intermittent, *clonic.* A convulsion usually begins abruptly and is of short duration.

In a **tonic convulsion** the muscles are strongly contracted, the limbs forcibly extended, the head retracted, and the body held rigid in a forced position; the spine may be completely arched (opisthotonos).

A **clonic convulsion** is characterized by abrupt jerky movements of the affected part. The two forms may occur in the same seizure, and frequently follow each other.

Convulsions are considered in two principal groups: those in which consciousness is lost and those in which, if present, it is retained.

The first group is known as *epileptiform,* the second as *tetanic;* epileptiform convulsions are, in common tongue, spoken of as *fits.*

Epileptiform convulsions occur in epilepsy; in conditions causing pressure to the brain, as apoplexy, fractured skull, brain tumor; in meningitis, uremia, alcoholism, and in poisoning by certain drugs. In young children epileptiform convulsions are common as the result of reflex irritation in many conditions; common causes are gastric disturbances, intestinal worms, teething, the onset of an

acute illness, especially of the infectious fevers, and in any other condition associated with rise of temperature.

In an epileptiform convulsion there is usually a comparatively short tonic contraction, followed by a longer period of clonic contractions. A characteristic feature is the closing of the hand over the inverted thumb. The eyes squint and are turned upward; the sphincters are relaxed, urine and frequently also the bowel movements are passed unconsciously; there is usually foaming at the mouth; the face is flushed, or may be first violently flushed, then pale.

Tetanic convulsions, as the name shows, are characteristic of *tetanus*, or lock-jaw. They occur also in poisoning by strychnin, in the condition known as *tetany*, and are the usual form of the hysteric convulsion. The contractions may be clonic or tonic. Prolonged tonic contractions are characteristic.

In the **general treatment** of a convulsion the patient should be placed where he cannot hurt himself; the clothing should be loosened, and a cork or small object placed between the teeth to prevent the tongue being bitten. The movements may be guided, but should not be restrained.

During a convulsion the patient must not be left. A message should be sent to summon medical aid; in the mean time close accurate observation of the symptoms may be an important aid to diagnosis.

The **chief points** to be observed are as follows:

1. Whether the convulsions are tonic or clonic, or whether one condition follows the other.

2. The area affected—whether the whole body, one-half of the body, or confined to a localized area.

3. The point at which the movements are first manifested, and the order in which the other muscles become affected.

4. The length of duration.

5. Twitchings of the facial muscles and the side toward which they are drawn; squinting; contraction, dilatation, or irregularity of the pupils; frothing of saliva at the mouth.

6. Relaxation of the sphincters, causing involuntary voiding of urine or action of the bowels.

7. Changes in the pulse or respiration.
8. Lividity or flushing of the face.
9. Premonitory symptoms, such as sharp cry, great restlessness, apprehension, etc.

Important points should be noted on the record chart, together with the hour of the occurrence of the attack.

Special treatment is, of course, directed toward treating the underlying cause and quieting the nerve-centers. In most conditions of epileptiform convulsions elimination is furthered by a quickly acting cathartic.

Epilepsy.—True or idiopathic epilepsy is a chronic disease characterized by failing mentality and recurrent convulsions. The attack is preceded by a loud cry, and the patient falls heavily where he stands. Frequently there is decided premonition of the attack, accompanied by some one peculiar sensation, which is known as the *aura*. The convulsion involves the whole body; consciousness is recovered immediately the convulsion is over. After an attack the patient is induced to rest, and usually sleeps heavily. The bromids are generally prescribed, and the bowels purged.

Where the convulsion is the result of injury to or acute disease of the brain, the treatment is the general treatment of the condition. The convulsions are generally confined to a definite locality, and sometimes only the face or one limb, at others one-half the body, may be involved. The convulsions are usually of the clonic variety. Consciousness is not recovered between the attacks, which are often prolonged indefinitely.

The **convulsions of alcoholism** and **uremia** bear many points of resemblance. In both there is frequently noisy delirium, and the convulsions may at first be mistaken for violent voluntary movements. Later the convulsions of uremia are markedly epileptiform, with coma, more or less profound, between the attacks.

To mistake the two conditions is an error that, should the case be one of uremia, might cost the patient his life.

Both conditions are the result of poisons in the blood acting on the nerve-centers. In a case of alcoholism, the poison having been ingested by the natural means, it can

be withheld, and can be eliminated by the natural excretions of the body. Recovery is generally anticipated. In a case of uremia the poison is a natural product of the bodily activity, by far the larger proportion of which is excreted in the urine, but which, owing to the failure of the kidneys to perform their function, has found its way into the blood. As long as life is present this poison must continue to be formed and to accumulate until the organs of elimination—the kidneys, the skin, and the bowels—can adequately fulfil their function. Uremia is a very grave condition, and not infrequently fatal. It occurs in conditions of nephritis, either due to disease or other causes.

The marked smell of alcohol on the breath in one case, and of a urinous odor on the other, will suggest the condition; on the other hand, it must be remembered that the first treatment of any abnormal condition among bystanders is usually to give alcohol; the odor may be, therefore, misleading.

The prominent characteristic symptom of uremia is the state of the urine. It is either scanty or entirely suppressed. What there is is loaded with albumin. In alcoholism the urine will probably be passed freely.

Two other points may be noticed. In uremia the coma is profound: in alcoholism the patient can generally be roused by shouting or violence. In uremia the pupils are usually contracted: in alcoholism they are dilated. In alcoholic seizure the pulse is full and quickened: in uremia it is usually slow and of high tension.

In hospital work the nurse will obviously not have the responsibility of either the decision or the treatment. She should, however, always remember to save carefully any urine that can be obtained for examination, and to examine the clothing for evidence of urine recently passed. In private work it may occur that she is called upon to give first aid in such a case, and she should realize the possible gravity of the condition and see that medical aid is promptly secured.

In **alcoholic convulsions** the treatment consists in administering an emetic or giving lavage, and in furthering elimination by a drastic purge, such as croton oil (1 to 3

minims). The patient is prevented, by shouting, shaking, cold affusion, etc., from sinking into coma. Fresh cold air should be admitted freely. Cardiac stimulants are given if the pulse shows signs of heart failure. If there is much delirium, an enema containing bromid and chloral in full doses is frequently prescribed. The after-symptoms of nervousness are treated according to their severity with various narcotics. Acute gastritis is commonly present, and is treated with rest, light diet, and purgatives.

In **uremia** the most urgent necessity is to produce active elimination. To induce the skin to act the patient is usually placed promptly in a sweat-bath or a hot pack (see Chap. II); at the same time pilocarpin ($\frac{1}{8}$ grain) is given hypodermically, and a drastic purge, such as croton oil (1 to 3 minims) or elaterium ($\frac{1}{6}$ grain), is administered by mouth. The sweat-baths or packs are continued until profuse sweating is produced, and repeated at intervals of two to four hours. The greatest care must be taken not to chill the surface of the skin by exposure while giving the treatment. If possible, such cases are best treated in a small room or ward, where the remperature can be evenly maintained at 70° to 80° F. At the same time, it is of the first importance that the air be fresh, and not allowed to become exhausted and the means of further poisoning. During the convulsions inhalations of chloroform are given, or chloral in full doses is prescribed by enema. In robust patients venesection is frequently performed, and from half a pint to a pint of blood removed, followed by the injection into the veins of one to two pints of water or of normal salt solution. The same is also given by hypodermoclysis or by rectum, with the object of diluting the toxin in the blood. Dry cupping over the loins is also a treatment frequently prescribed. If cyanosis is marked, inhalations of oxygen are necessary, but it should be remembered that the condition may be due to the exhausted atmosphere of the room, and fresh air admitted may improve the condition. Between the convulsions the patient may be partially conscious, wildly delirious, or sink into a profound coma. If conscious, he may complain of headache, vertigo, or total blindness. The attacks fol-

low each other with more or less rapidity. Sometimes hardly any pause is perceptible between the convulsions. Such a state is described as the *status epilepticus.*

If the patient recovers, the treatment consists in rest in bed, a diet chiefly of milk and farinaceous foods, and the use of sweat-baths until the albumin has disappeared from the urine, and free purging, usually with salines. Headache, vertigo, and disturbances of vision are symptoms that are persistent. There may be temporary total blindness. The patients are usually extremely anemic, and require tonics, such as iron, and plenty of fresh air and sunlight.

Uremia may occur as a complication in *pregnancy,* labor, or during the puerperium. It is then known as *eclampsia.* Correctly speaking, the term eclampsia may be employed in any convulsive seizure from a temporary cause, as, for example, the reflex convulsions of children. Generally, the use of the term is restricted to the above condition. Where the case is serious, abortion is generally produced, or the actual labor hastened by artificial dilatation and the use of forceps. After delivery the symptoms usually quickly improve. In other respects the treatment is the same as described above.

Convulsions in children signify less than the same condition in adults; their nervous centers, being in a less stable condition, are easily upset by minor causes. The gravity of the condition depends on the cause (see above). In excitable children violent emotion may be sufficient cause.

The customary treatment during the convulsion is immersion in a hot tub-bath (100° F., rising to 105° F.), with, at the same time, the application of cold to the head. The bath is usually prolonged until relaxation is complete, and repeated if the convulsions recur (p. 669). An enema is generally given at once, followed by a purgative, commonly castor oil or calomel, the dose according to the age. The convulsions are apt to recur at intervals until the condition has been relieved, or, if ushering in an acute illness, until the period of invasion is over. The temperature is generally raised, sometimes very high; the pulse is full and

rapid. If a child is very restless or delirious, a hot pack in which he can remain for an hour or more is often more efficacious than the hot tub.

Convulsions of Tetanus.—Tetanic convulsions, so called, are chiefly tonic in character, and accompanied by extreme pain. The convulsion is aggravated by any small disturbance, such as a touch or a sudden noise. A leading characteristic is the stiffening of the muscles of the jaw, finally causing lockjaw (*trismus*).

As we have already seen, *tetanus* occurs only from infection by the *tetanus bacillus*, introduced through a wound by direct inoculation, and most commonly developing in punctured wounds contaminated by soil or other dirt.

The *first* symptom is a difficulty in swallowing, with a feeling of stiffness about the jaws. The first suggestion of such a symptom must be promptly reported. The stiffness gradually extends to the neck, the shoulders, the back (which becomes completely arched), the abdomen, and extremities; not infrequently the arms remain free. The contractions are almost entirely tonic. The muscles remain rigid between the convulsions; consciousness is not lost during the attacks. The seizure is usually accompanied by profuse sweating and fluctuations of temperature. In a mild form of tetanus the spasm is confined to the head and shoulders, and the jaw is not completely locked. Where the larger part of the body is involved and the jaw completely locked, the condition is very frequently fatal. (See also p. 647.)

Convulsions from strychnin poisoning closely resemble those of tetanus. The first symptom is, usually, some mental exaltation, with sharpening of the special senses, especially that of hearing; the spasms begin in the extremities, with twitchings (clonic contractions) of the fingers and toes. Tonic contractions follow, extending over the whole body, and involving the jaw *last*. As in tetanus, in acute cases the back is completely arched. The muscles are *relaxed* between the convulsions; consciousness is not lost. The pain is frequently agonizing. (See Poisons, p. 351.)

During the course of *spinal meningitis* rigidity and tonic

contractions of the muscles of the back and shoulders, associated with local tenderness and pain, are characteristic symptoms. The paroxysms occur at intervals. During a paroxysm the back may be so completely arched that the soles of the feet rest on the back of the head. The treatment is, of course, that of the underlying disease.

Tetany, a disease seen usually in rickety children, is also characterized by tonic contractions of the legs and arms, usually occurring in paroxysms. The limbs are contracted toward the median line of the body, the feet being turned in until the soles meet. Hot baths are sometimes used to favor relaxation, but the chief treatment is directed toward the underlying cause and the reëstablishment of health.

A **hysteric convulsion** may simulate any of the above forms. It is a characteristic symptom that, as a rule, no one group of symptoms is followed exactly. The patient is not unconscious, but keeps the eyes persistently closed, and resists attempts to open them. He can generally be roused by sharp pressure on the supra-orbital notch. The sphincters are not relaxed, the pupils react to light, the pulse remains unchanged, and the face is neither pallid nor deeply flushed. If the patient falls, it is in a position where he will not hurt himself. He may be noisy, and simulate delirium or mania, or perfectly quiet, as though comatose.

Opinions and practice vary greatly as to the treatment of hysteria. To some extent the treatment is always one of suggestion. If a nurse is with such a case, she must realize that only by perfect control herself can she control or help her patient. Scolding and punishments rarely obtain desired results. Nurses must frequently be warned against treating hysteria as though it were a mere display of childish temper. For the time the patient is in an abnormal condition. Where possible, pains should be taken to get at, either through the friends or from the patient, the underlying cause of the attack. It may be mental, the result of shock, grief, or worry, or physical, due to alcoholism or possibly some debilitating disease. In nervously constituted patients, especially women, minor causes,

such as constipation or the monthly period, may induce hysteric outbursts. In every case possible the removal of the cause is the first step in successful treatment.

REMOVAL OF FOREIGN BODIES

A **foreign body in the eye** causes pain and local irritation, shown by the increased secretion of tears and congestion of the blood-vessels of the conjunctiva. If this condition is unrelieved, serious inflammation may result.

The patient should first be directed to keep the eyelid closed, and refrain from rubbing the eye, which may embed

Fig. 207.—Eversion of the upper lid (Manhattan Eye, Ear, Nose and Throat nursing book).

the particle in the eyeball. Allowing a few seconds for the tears to collect, the nose is smartly blown, and the particles will, in many cases, be found to be washed by the tears down the lacrymal canal into the nose. A second method is to take the upper lid by the lashes and pull it well over the under lid, by which movement the particle may be swept on to the cheek. Failing these means, the lids should be everted. The lower part of the conjunctival sac is freely exposed by pulling the under lid

down toward the cheek bone, and directing the patient to look upward. The upper lid is taken by the lashes and turned upward and backward. The movement is made easier by placing a probe, a knitting-needle, etc., on the lid, over which it is turned. At the same time the patient should be told to move the eyeball freely about, so that the surface may be examined. The fragment is removed by a gentle wiping movement, using a camel's-hair brush, a feather, or some soft clean material. No force must be used. If the eye is irritated and painful after the removal, a warm boric douche may be given, and a little white vaselin or a few drops of sweet or castor oil be laid between the lids and a pad and bandage applied for a short time.

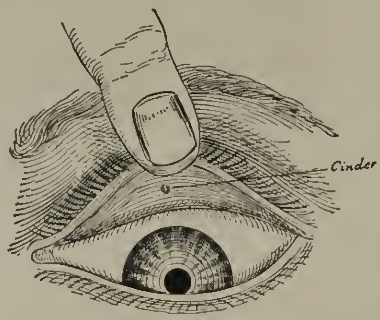


Fig. 208.—The upper eyelid everted (Pyle).

Should the fragment not be perceptible, a douche of warm boric solution should be given, or the eye held open in a basin of warm water and the lids shut and opened rapidly. If the fragment is seen to be embedded in the eyeball or fails to be removed by the simple means described, surgical assistance should be at once obtained. *In all cases of injury to the eye prompt treatment is an urgent necessity.* In some cases the fragment may be so small as to be imperceptible without a lens. In others, especially with fragments of metal from machinery, the fragment may be driven deep into the tissues of the eyeball.

Foreign Body in the Ear.—In the case of children a foreign body in the ear is usually a pea or some small object

poked in in mischief. Occasionally an insect crawls in the ear and, by the noise of its movements, causes acute discomfort.

No attempt should be made to remove the body with a probe, a pair of forceps, a hair-pin, or other object. To do so will almost certainly push the object further in, and may injure the tissues.

The patient is laid on the side, the affected ear uppermost. The ear is then filled with a little warm sweet oil dropped from a pipet; the object will probably float to the top, and is easily removed.

To remove an insect the same method may be used, or a plug of cotton saturated with vinegar or with strong salt and water can be inserted in the ear. Over the plug a pad is held firmly and the patient directed to lie on the affected side. On removal after a short time the insect will generally be found on the plug.

Syringing, unless done by experienced hands, is liable to wash the object further in. Vegetable substances (as a pea) should not be moistened, as they swell and become more difficult to remove. A small hard substance that will not float may require gentle syringing. (See Ear Douche, p. 135.)

A **foreign body in the nose** is also generally the result of mischievous poking. Small objects may sometimes be dislodged by violent sneezing excited by pepper or snuff or by blowing hard down the affected nostril while the other is held compressed. If these means fail, a nasal douche may be gently given through the unaffected nostril (see Nasal Douche), unless the substance is one that will swell with moisture. If the object is immovable, surgical aid must be sought. If this is not procurable, an attempt may be made to snare the object with a small loop made of a piece of clean wire. If the tissues are at all scratched, the removal should be followed by a warm boric douche.

Foreign Body in the Throat.—Small substances, such as particles of food, are frequently dislodged by drinking water or swallowing a morsel of well-chewed bread. A larger substance may lodge near the top of the esophagus

and cause acute pain, choking, and possibly asphyxia, from pressure on the windpipe.

The *esophagus* is an elastic tube. Near the top, however, its expansion is restricted by the one complete cartilaginous ring in the formation of the trachea. It is at this point that hard substances are liable to stick. A sharp slap between the shoulders will frequently dislodge the substance, sending it into the mouth or below the point of obstruction, when it can readily pass into the stomach. To be more effectual, a child may be held inverted, or a larger person directed to lean forward over the back of a chair. If this does not avail, water or bread may be swallowed or vomiting induced by pushing the finger down the back of the throat. If the patient is quiet, it is often quite easy to reach the object with the finger and remove it or force it beyond the obstruction.

A fish-bone or other sharp substance embedded in the tissue of the throat, if it can be seen, is generally easily removed by a pair of forceps, the patient holding his throat open in a good light, and the tongue held down with a spoon or other suitable object. If it cannot be seen, the patient should be taken to a doctor, who will remove it with an instrument known as the horsehair probang.

A *probang* is an instrument used in esophageal treatment, resembling a bougie, and usually made of gum elastic. For ordinary treatments a small sponge is attached to one end. The *horsehair probang* has, near the point, an interruption filled with a skein of fine stiff hairs. On pulling on a wire inserted in the probang, the point is pulled toward the operator and the hairs stick out all round, very much like an open umbrella. The foreign body becomes enmeshed in the hairs, and is thus removed. Where more solid objects, such as coins or buttons, are lodged in the esophagus, a special probang, called the coin-catcher, is used. In this, the tip of the bougie is provided with small flat pockets. It is inserted beyond the object, and when withdrawn may, if the object is movable, catch it in one of the pockets. A coin permanently lodged in the esophagus is not an uncommon accident with children; it causes partial stricture, shown in the inability to swallow

solid foods. Should the coin-catcher fail to recover the object, it is located by means of an x-ray photograph and removed by a surgical operation.

If a sharp substance, such as a fruit-stone, fish-bone, pin, or a small toy, has been swallowed, means must be taken to prevent injury to the mucous membrane of the alimentary canal. Purgatives should not be given at first. The patient should eat liberally of cereal or new bread, sub-

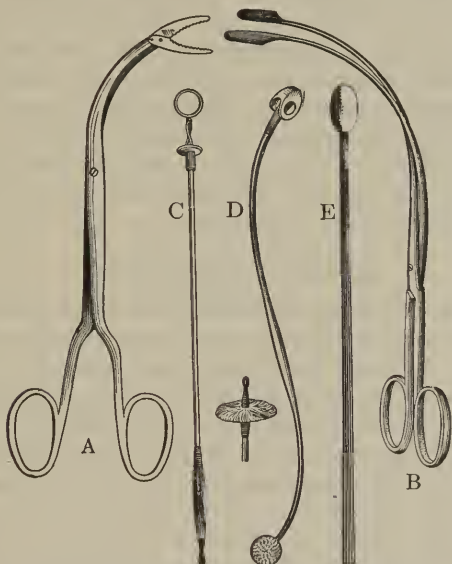


Fig. 209.—Esophageal instruments: A, B, Forceps; C, horsehair probang; D, coin-catcher; E, esophageal bougie (Da Costa).

stances in which the object may become embedded. A couple of hours after he should be given a meal of figs, prunes, or cooked apples, which will act as a gentle purgative. The stool should be examined for the missing object.

Foreign bodies in the larynx or trachea consist usually of fluid or food-particles lodged there as the result of choking, vomiting, or in consequence of paralysis of the soft palate. Their presence causes dyspnea and coughing, which may result in the ejection of the irritating substance. In

this circumstance a blow on the back will only deprive the patient further of breath and make matters worse.

If the patient becomes asphyxiated, artificial respiration should at once be begun, and surgical aid secured. Laryngotomy or tracheotomy may be necessary in order to remove the foreign body and to enable the patient to breathe.

A fluid in the larynx, while producing symptoms less immediately alarming than those caused by a solid substance, is nevertheless more difficult to remove entirely. Some portion will almost certainly escape down the trachea; in the lungs it becomes decomposed, and is frequently the cause of septic pneumonia. Where paralysis of the soft palate exists, fluids should not be given except by a nasal or stomach-tube. Solids or semisolids are less dangerous, as the muscular action of the cheeks and the tongue passes the bolus to the back of the throat.

ARTIFICIAL RESPIRATION

Artificial respiration is necessary when, for any cause, the mechanical act of respiration ceases while life is not destroyed. Arrested respiration produces the condition known as *asphyxia*, of which the accompanying symptoms are lividity, cyanosis, and loss of consciousness.

Causes.—Asphyxia may result from the following causes: Mechanical obstruction, as in drowning or edema of the lungs, where the lungs are filled with water; the lodging of a foreign body in the trachea; edema of the glottis; inflammation or morbid growths of the larynx; pressure of a tumor on the trachea or bronchi; a foreign body, such as a bone, in the esophagus, pressing forcibly on the trachea.

Convulsive spasm, as in whooping-cough or croup.

Paralysis involving the muscles of respiration, as in shock from lightning or electricity, and in injuries to the upper part of the spinal column.

The inhalation of poisonous gases.

The administration of a general anesthetic, especially *ether*.

In the new-born, from failure of the lungs to expand.

Where it is possible to remove the obstruction, this is obviously the first step in the treatment of asphyxia. In any other case artificial respiration should be begun *without a moment's delay.*

Where there are fluids to be expelled from the lungs and bronchi, the patient is placed on his face, the head hanging so that the mouth is lower than the trunk. In other circumstances he lies on his back, a thick pad under the shoulders, and the head thrown back lower than the chest. In this position the throat is extended and the muscles of the chest-wall are allowed free play. The tongue is grasped with a handkerchief or by a pair of forceps, and pulled forward and to one side, to prevent its falling back and mechanically closing the larynx; a small object is placed between the teeth, to keep the mouth open. In case of vomiting the head should be kept turned to one side. The clothes are loosened round the throat, chest, and abdomen. Any collection of mucus in the nose or throat must be quickly wiped away.

There are several methods of giving artificial respiration, of which the most commonly employed are known as the *Sylvester method* and the *Marshall Hall method.*

The Sylvester Method.—The patient is placed on his back, as just described, the tongue drawn out and to one side. Seizing the arms just above the elbow, they are *slowly* abducted, extended at right angles to the body, and brought together above and behind the head. By these movements the chest-wall is slowly expanded, as in the natural act of inspiration. The throat being extended and the tongue drawn out, the air-passages are held open. The arms are held together above the head for three or four seconds. The movements are then slowly reversed, and the arms pressed forcibly against the sides of the chest for about three seconds, causing the act of expiration. The movements are continued rhythmically. *They must not be hurried:* 12 or 14 times a minute, somewhat lower than the normal respiration, is sufficient.

The Marshall Hall Method.—The patient is laid on his side, a thick roll of blankets or pillows under the chest, and the arms placed above the head. The head is low, the

throat extended, and tongue drawn out, as in the Sylvester method. The patient is turned alternately on his face, to compress the chest (expiration), and on his back, to allow

Fig. 210.—Artificial respiration: first movement, inspiration (Murray).

the chest to expand (inspiration). While on his face, expiration is further aided by pressure on the ribs from behind. Again, the movements must be continued rhythmically, and not more than 12 to 14 times a minute.

Fig. 211.—Artificial respiration: second movement, expiration (Murray).

Drowning.—In asphyxia caused by drowning the lungs and air-passages must be freed from water. To do this, the patient must be placed in such a position that the head

and shoulders hang low, when the water will naturally escape by the mouth and nose. A child may be held by the legs head downward, or placed across the knees, face downward, the abdomen over the knees, and the head and shoulders hanging low. A larger patient may be laid in the same way across a table, a barrel, the seat of a boat, a bale of goods, or anything available that can be rolled into a bundle sufficiently large so that pressure comes on the lower part of the chest and the abdomen, and the head and shoulders can hang down. The tongue is pulled out and held to one side. At the same time the ribs are pressed at the sides and back to help in emptying the lungs. Artificial respiration, as described above, is then promptly begun. It should be continued as long as there is *any sign of action of the heart.* Recovery may occur after several hours. While artificial respiration is being carried out, no time should be lost in making every effort to restore the circulation and stimulate the heart. Bystanders should be directed to remove the wet clothing and cover the body with warm blankets, etc., and to apply friction, under cover, to the extremities. Stimulants, especially atropin ($\frac{1}{100}$ to $\frac{1}{60}$ grain) and strychnin ($\frac{1}{25}$ to $\frac{1}{15}$ grain), are given by hypodermic; whisky or brandy may be given by rectum. Counterirritants in the shape of a sinapism or poultice may be applied over the heart; cold water may be dashed over

Fig. 212.—Expressing water from the stomach and lungs (Murray).

the chest, or, if available, a current of electricity may be applied. Fluids, such as normal salt solution by enema or hypodermoclysis, are avoided. On recovery, the usual reaction from shock may be present, especially in nervous patients. Until completely recovered, patients should be kept in bed and quiet.

Asphyxia of the New-born.—In the new-born, failure of the lungs to expand may be due to—(1) Blocking of the air-passages with secretions; (2) delayed reflex action; or (3) lack of vitality. In the first two conditions the baby is cyanosed (blue asphyxia); in the third, the skin and mucous membranes are livid (white asphyxia), and the baby shows no sign of vitality.

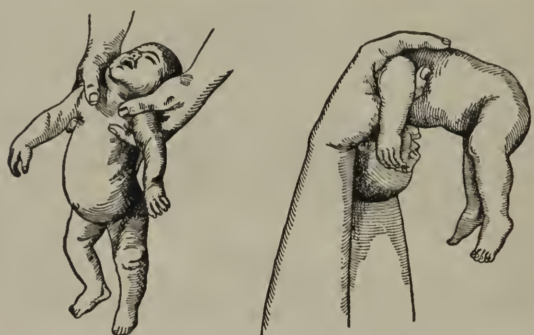


Fig. 213.—Schultze's method of artificial respiration (Hirst).

The first step in the treatment is to wipe the nose and mouth free of secretion. If the skin is cyanosed, the baby should be slapped smartly on the back, which is often sufficient to excite respiration as a reflex action, or the ribs may be compressed several times in succession. If these means fail, two methods of artificial respiration are usually employed in preference to either described above, although the Sylvester method is also frequently used.

The Schultze Method.—The baby is held at arm's length, suspended by each axilla, the back turned toward the operator. The hands of the operator are held with an index-finger in each axilla, the thumbs over the clavicle,

and the palms and remaining fingers against the back, on either side of the spine. In this position the baby is swung forward and upward, so that the lower half of the body is doubled over the upper and the abdomen com-

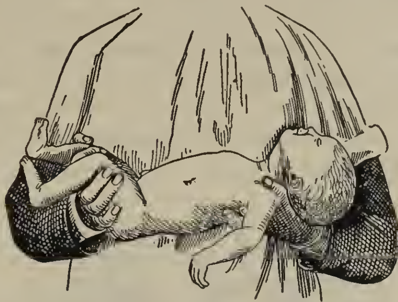


Fig. 214.—Byrd's method of artificial respiration: first position (Dorland).

pressed against the chest. After one or two seconds the movement is reversed. The movements are repeated about 14 to 18 times a minute.

The Byrd Method.—The baby is taken in both hands. The right is placed behind the shoulders, the thumb and

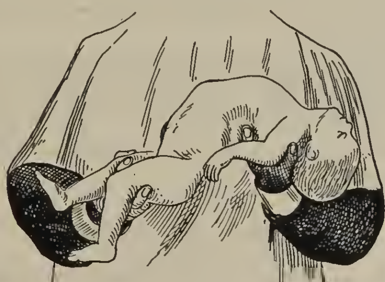


Fig. 215.—Byrd's method of artificial respiration: full inspiration (Dorland).

index-finger brought over the clavicles, on either side the neck. The left hand grasps the buttocks. Between the hands the body is then doubled, using gentle force, and the

abdomen compressed against the chest; by the reverse movement the body is extended until the spine is arched. The movements must be done slowly, and repeated about 14 to 18 times a minute.

In the condition of *white asphyxia* the baby is usually placed in a hot bath (100° F., increased to 105° F.). Under these circumstances the sides of the chest may be taken between the hands, and gentle, forcible pressure made and relaxed from 14 to 18 times a minute. The chin must be kept up and forward, and the tongue drawn out and to the side.

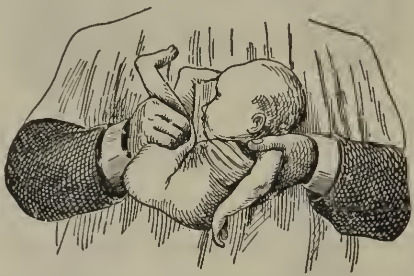


Fig. 216.—Byrd's method of artificial respiration: full expiration (Dorland).

The gums and lips at the same time may be rubbed with brandy and water.

Examination of a new-born infant may show that the chest-wall has expanded unequally, although the baby may appear to be breathing comfortably. In this circumstance also artificial respiration must be practised until the condition is rectified.

FAINTING OR SYNCOPE

Fainting is a condition involving temporary loss of consciousness, either partial or complete, the result of a change in the force of the action of the heart.

The heart's action is controlled both by the central nervous system and by the sympathetic nervous system. Conditions that affect either system may cause a temporary suspension of the activity of the heart and produce syn-

cope. Causes affecting the central nervous system are anemia of the brain, as in cases of hemorrhage, an insufficient supply of oxygen in the atmosphere, exposure to heat, and poisoning by certain drugs, especially the cardiac depressants. Causes acting through the sympathetic nervous system may be emotional, such as fear, joy, apprehension, an offensive sight, or poisoning by a drug that acts on the inhibitory nerves of the heart (sympathetic), such as digitalis.

Premonitory symptoms of an attack are: a sensation of weakness, giddiness, and inability to stand; ringing in the ears; the sense of blindness; a clammy skin or profuse sweating. During the attack the patient loses consciousness and sinks to the ground; the muscles are completely relaxed, the pulse is small and weak, the breathing shallow, the face and lips pale, and the eyes closed.

The treatment is to lay the patient flat, with the head and shoulders lower than the rest of the body, to loosen the clothing about the throat, chest, and waist, and admit fresh air freely. When consciousness is regained, water or aromatic spirits of ammonia (60 minims in $\frac{1}{2}$ ounce of water) should be given. If the attack is prolonged, the respiration may be stimulated by smelling salts or burning feathers, the hands and face sponged with cold water and briskly rubbed, or reflex action may be encouraged by slapping the chest smartly above the heart.

After an attack of syncope the patient should lie still and not attempt to sit up or walk until fully recovered, or the attack may recur.

CEREBRAL CONCUSSION, HEAT-STROKE, STARVATION

Concussion, or cerebral shock, is the effect on the brain of a fall or direct violence, where there is no lesion of the brain substance. The function of the brain is temporarily arrested or *stunned*.

Usually there is a short interval of insensibility, with symptoms of syncope, pallor, and small, feeble pulse; the respirations are quiet, whereas, in conditions of brain *injury*, stertorous breathing is an early symptom; as consciousness returns there are sensations of dizziness, head-

ache, and nausea; vomiting is frequently present, and the mental faculties may be confused. After resting, the symptoms may pass away entirely.

In more severe cases a semicomatose condition persists for some days. The patient lies with eyes closed, indifferent to all that passes, but can be roused by talking or shouting. The mind is generally clear, but not infrequently there is no memory for events immediately preceding the accident.

Rest in bed with the light shaded, the administration of a purgative, and a liquid diet until the symptoms disappear are usually all the treatment necessary. Persistent headache is relieved by the application of an ice-bag.

Heat-stroke, thermic fever, insolation, sunstroke, are names used to describe a condition resulting from undue exposure to heat or to the direct rays of the sun.

There are two distinct varieties, heat exhaustion or prostration, and heat-stroke proper.

Heat Exhaustion.—The symptoms are exhaustion, sensation of great weakness, clammy skin, cold extremities, small, feeble pulse, and shallow respirations. As a rule, consciousness is not lost, but syncope may occur.

The patient must be moved out of the sun and placed in the recumbent position, with the head low; the clothing must be loosened, fresh air admitted, and external warmth, such as blankets and hot-water bags, applied; cardiac stimulants, especially aromatic spirits of ammonia (60 minims) or strychnin ($\frac{1}{30}$ to $\frac{1}{15}$ grain), are given, and water or hot tea or coffee to drink. The patient should rest until entirely recovered. As a rule, there are no after-effects. For some days the action of the heart may remain weak. Usually rest and avoidance of exertion is all the treatment necessary.

Heat-stroke is a condition of great gravity, and if unrelieved is quickly fatal. Some cases terminate fatally in less than an hour. The usual patients are men that have been doing hard physical labor in a high temperature. There may be premonitory symptoms of vomiting and acute headache. The patient rapidly becomes unconscious, the surface of the skin is deeply flushed and cyanosed, the

eyes bloodshot, the pupils contracted, perspiration is arrested, the temperature rises rapidly to from 105° to 110° F., the pulse is rapid and small, the respirations either stertorous or rapid and shallow. Convulsions or delirium may be present.

In the treatment not a moment must be lost. The patient is moved out of the sun, the clothes stripped, and cold in the most immediately available form applied to the whole body. The water-hose, cold bath, ice rub, or the cold pack, frequently changed, are the usual means employed; plenty of fresh air must be available. Cold rectal irrigation is also frequently used. The treatment must be carried out constantly until the temperature drops and the patient perspires naturally. The pulse must be closely watched and cardiac stimulants given if necessary. In patients of robust appearance, venesection ($\frac{1}{2}$ to 1 pint), followed by infusion of hot normal salt solution, is sometimes prescribed.

On recovery, the patient is put to bed in a darkened room with plenty of fresh air. A purge is given and the action of the skin and kidneys encouraged by drinking water freely. An ice-bag should be kept on the head. In severe cases convalescence is slow and is treated with prolonged rest and quiet, and careful attention to diet and to the condition of the bowels and kidneys. Exposure to the sun must be avoided.

Where prompt treatment is available, recovery may be looked for. After-effects frequently met with are impairment of the memory, failure of mental power, a tendency to severe headache, and inability to bear exposure to heat or to the direct rays of the sun. One attack predisposes to another.

In tropical countries exposure to the sun has been known to cause acute meningitis.

In Animals.—It is humane to remember that animals, particularly horses and dogs, leading the artificial life of the cities, are also liable to heat-stroke. In dogs it is often shown by an attack of wildness and extreme excitability, ending in convulsive seizures, from which they usually recover.

The condition may often be averted by keeping animals out of the sun and supplying them with sufficient drinking-water. Horses, if obliged to work, should be kept as much as possible in the shade, should not be hurried, and should have their mouths and nostrils frequently sponged with cold water.

Starvation as an emergency is usually complicated by exposure. The condition is one of general collapse, frequently accompanied by coma. The patient should be put to bed, external warmth applied, and the extremities briskly rubbed. Food in fluid form is given in very small quantities, gradually increased at regular intervals. Hot normal salt solution is given by rectum or by hypodermoclysis. Cardiac stimulants are generally given by hypodermic injection. Reflex vomiting may occur as the nerve-centers react to treatment, and it may be necessary for a time to give the nourishment by rectum. Convalescence is usually rapid unless complicated by the consequences of exposure, such as pneumonia, inflammatory rheumatism, etc.

CHAPTER XX

SYMPTOMS AND CONDITIONS FREQUENTLY MET WITH

Pain—Delirium—Delusion—Illusion—Hallucination—Coma—Coma Vigil—Insomnia—Paralysis—Hemiplegia—Paraplegia—Edema—Dropsy—Vomiting—Hiccup—Constipation—Diarrhea—Rigor—Sweating—Sudamina—Fever: Causes; Varieties; Course; Incubation—Eruptions: Some Other Skin Eruptions.

PAIN

PAIN is a *subjective* symptom (p. 180), and as such should be described in the words of the patient. At the same time the condition is commonly accompanied by certain *objective* symptoms, which must be carefully noted.

The **chief causes** of pain are inflammation, injury, pressure, as from a tumor, a collection of fluid in a circumscribed area, or an obstructive body, such as gall-stone; and acute irritation of a nerve, as in facial neuralgia.

The **subjective symptoms** of pain include the *character* of the pain, its *location*, and its *duration*.

Varieties.—Pain is described as *dull* or *sharp*. A dull pain may be *aching* or *boring;* a sharp pain may be *cutting*, *shooting*, *throbbing*, or *griping*. A sharp shooting pain is sometimes described as *lancinating*.

Throbbing pain is due to local congestion, and frequently associated with the formation of pus. *Boring* pain is usually caused by persistent pressure, as from a tumor. It is a characteristic symptom, for example, of thoracic aneurysm.

Pain is always more or less localized; in some conditions it may involve a very large proportion of the body. Thus in some infectious conditions (smallpox, influenza, diphtheria) we have acute pain in the back, lower extremities, and head. In acute inflammatory rheumatism and in pyemia we have pain attacking many of the joints simul-

taneously, and disappearing from one part of the body, to reappear immediately in another.

Pain may be *continuous, intermittent,* or occur in *paroxysms.* Neuralgic pain has a tendency to recur in paroxysms at regular intervals.

The **onset** of pain may be sudden or gradual, and it may also disappear suddenly or gradually. Sudden relief from acute local pain usually suggests the removal of pressure or of an obstruction; thus in the sudden relief of toothache we have an escape of fluid into the soft tissues; an abrupt cessation of pain in an attack of renal or hepatic colic indicates the escape of an obstruction into a less constricted passage.

Objective symptoms to be noticed in reference to pain are: Changes in the pulse or respiration; the existence of swelling, discoloration, deformity, or local tenderness; the expression of the face, whether drawn and pinched, or worn and apathetic; moaning or crying; the attitude assumed, and whether pain appears to be increased by moving or touching.

In acute abdominal pain the tendency is to draw the knees up, in order to relax the abdominal muscles; in pleurisy the patient lies on the affected side, in order to restrict the painful movement during respiration; in colicky pain the body is sharply doubled to relieve the contractions.

Remedies used for the relief of pain are called anodynes or analgesics. They may be systemic, acting through the nervous system, or local.

Of the systemic anodynes, the most important is opium, especially its principal salt, morphin. Others are belladonna, cannabis indica, hyoscyamus, antipyrin, acetanilid, phenacetin, and many others.

Local anodynes are heat, especially moist heat, cold, the different forms of counterirritation, and several drugs,—belladonna, camphor, chloroform, etc.,—usually applied in the form of liniments or plasters.

A condition in which pain when afflicted is not felt is known as *anesthesia.* Unless produced by the action of a general anesthetic, it is due to paralysis of the sensory nerves. It may be strictly local, as in the facial paralysis

often temporarily following a mastoid operation, or as produced by a local anesthetic; or it may involve half of the whole body, as in paraplegia.

Hyperesthesia is an abnormal sensitiveness to touch, and is most commonly found associated with neurasthenia or hysteria. Absence of pain may sometimes be a grave symptom. Thus in accidents to the spine no pain is felt below the seat of injury, owing to total paralysis caused by pressure on the spinal cord; in a deep burn pain is absent, owing to the destruction of the nerve-endings; in cases of severe shock, pain is frequently not experienced, even in violent injuries.

DELIRIUM

Delirium is an acute disorder of the mental faculties, due, commonly, to disease. Two types are recognized, *low muttering delirium* and *wild delirium.*

The **low muttering delirium** is characterized by disconnected, irrational speech, restless impulses, and impaired will and motor power. Disturbing dreams and attacks of weeping or excitement are common. In mild cases the delirium is intermittent and the patient can frequently be roused to answer questions sensibly. In more severe cases the muttering is constant, the patient appears insensible to his surroundings, and fails to show any recognition of his friends. The stools and urine are passed involuntarily. Plucking at the bed-clothes, or *carphology,* is a frequent symptom. Low muttering delirium is common in all the acute infectious fevers. In typhoid fever it is to some extent almost invariably present. Where restlessness is a feature, the patient continually tries to get out of bed, and not infrequently to escape by the window.

Low muttering delirium is commonly treated by hydrotherapeutic measures, especially the cold tub-bath or the wet pack. Either of these measures almost invariably relieves the symptoms for a time.

Wild delirium is a condition of maniacal excitement. It is usually associated with toxic conditions not due to bacterial infection. The deliriums of uremia, alcoholism,

and of poisoning by a certain class of drugs are examples. The drugs which induce delirium are known as deliriants; such are belladonna, stramonium, hyoscyamus, and others. Patients of alcoholic habit frequently develop wild mania in the course of an acute infectious disease. The patient is noisy, violent in his actions, insensible to his surroundings, and difficult to control. The eyes are wide open and staring, and usually dilated; the face is flushed; the speech is incoherent and rapid. The condition is generally controlled by the use of sedatives or narcotics, and the patient's general health is carefully supported by regular nourishment. In alcoholic cases a certain amount of stimulation is usually necessary. The treatment includes the means for eliminating or neutralizing the poison. Enforced physical restraint may be necessary.

Delirious patients require watching, even when the symptoms seem mild. The character of the delirium may change abruptly, and the patient escape by the window or do himself other injury. In wild delirium a homicidal mania may develop. The means for quick restraint should always be at hand. The fact should be borne in mind that delirium may develop suddenly in any condition associated with high temperature, and such patients should constantly be under close supervision.

Delirium due to great exhaustion is frequently associated with the end of a long illness or conditions of low vitality, such as following shock or profuse hemorrhage. The chief treatment is in the support of the patient's strength by regular nourishment, stimulation, hypodermoclysis, or intravenous infusion of normal salt solution, and so forth.

The **wild delirium** associated with acute alcoholism is known as *delirium tremens*, from the tremors (subsultus) which characterize the condition.

DELUSION, ILLUSION, HALLUCINATION

Delusion is the persistent possession, by the mind, of a false belief, sufficiently strong to influence the actions; for example, the fixed conviction that the life is threatened.

Illusion is a false conception concerning some actual

material object; for example, the mistaking of a piece of furniture for a wild beast.

Hallucination is a perception of objects or sounds that have no demonstrable existence; for example, the hearing of voices or the seeing of imaginary persons or animals.

COMA

Coma is a condition of complete unconsciousness. The appearance is that of deep sleep; in certain conditions it may be accompanied by delirium.

Coma may occur in any condition associated with profound exhaustion, such as the end of a long illness, severe shock, or following profuse hemorrhage; in toxic conditions, as the infectious fevers, uremia, alcoholism, and the acetonuria of diabetes, and in poisoning by many of the functional poisons. It is a symptom in many diseases of the brain, and one of the early evidences of brain pressure. In this condition it is accompanied by changes in the respiration, most commonly stertorous breathing.

The coma due to a toxin may be relieved by means to eliminate or neutralize the poison. In the coma due to alcoholism, opium poison, and like causes, efforts are made to rouse the patient by talking, shouting, enforced movements, cold affusions, etc. Diabetic coma is regarded as a fatal condition, though the patient may linger a few days. Coma accompanying a condition of profoundly lowered vitality is treated by prompt stimulation, external heat, infusion or hypodermoclysis of normal salt solution, and other means described under Shock or Collapse.

In the large majority of cases death is preceded by a period of coma of short or long duration. Stimulation of the vital centers by atropin, strychnin, camphor, etc. or the injection of normal salt solution, may prolong the condition and in some cases induce a temporary return of consciousness. In many conditions this form of coma is accompanied by Cheyne-Stokes' respiration.

Coma vigil is the name given to a state of unconsciousness where the eyes, the pupils dilated, remain open, with an intensely watchful gaze. The condition may be accompanied by delirium. It is seen in conditions of extremely

lowered vitality, and is always a grave symptom, generally signifying approaching death.

Other conditions of unconsciousness, usually attributed to hysteria or disturbed mental conditions, are—*trance* or simulated death, *catalepsy*, in which the patient, apparently insensible, will remain for a long period in any fixed position, and *ecstasy*, an exalted condition frequently accompanied by extravagant movements, such as dancing, during which the patient is apparently insensible to his surroundings.

INSOMNIA

Insomnia, or inability to sleep, is a common occurrence in most disturbed physical conditions, and especially so in conditions associated with fever, with pain, or following a severe physical or mental strain, such as an accident or an important operation. In the acute fevers there is little or no natural sleep during the fastigium, or febrile stage. The return of natural sleep is a favorable symptom; it is frequently a feature of the crisis.

Acute insomnia in persons of alcoholic habit is generally a preliminary symptom of delirium tremens, and for this reason is always promptly treated. In middle age and elderly people, occurring especially after a shock or a long exhausting illness, insomnia is not infrequently the first sign of insanity.

In the acute fevers, insomnia, unless associated with great restlessness, is not usually specially treated. A tepid or hot-water sponging, an ice-bag to the head, attention to comfort and quiet, will predispose to as much sleep as is possible. In these conditions patients are indifferent to the passing of time, and loss of sleep is rarely complained of. In loss of sleep due directly to pain, anodynes are commonly given, of which the most potent is opium in some form, usually morphin, given hypodermically. Where acute pain is not a feature, milder drugs, such as antipyrin, phenacetin, sulphonal, veronal, and many others, should always be preferred to morphin; they have less constitutional effect, and there is not the same risk of forming a habit.

In giving drugs to relieve incidental insomnia, much judgment must be exercised by those to whom the giving is intrusted. Other means to induce sleep should be tried first. Evening visitors and excitement should be forbidden: quiet occupation or reading aloud substituted, and the patient's attention diverted from his own condition; his comfort should be carefully attended to, and disturbing noises prevented as far as possible. A warm tub-bath, when practical, or a sponge-bath, an alcohol rub, a hot-water bag to the feet and cold applications to the head, or massage of the spine and forehead, may often prove efficacious.

If the administration of the drug becomes necessary, it must be given after every other duty connected with the patient or the sick-room is finished. It seems hardly necessary to add that a sleeping patient must not be roused for a sleeping draft; but in intrusting the administration of medicines to a pupil, she must at least be carefully instructed as to which medicine is for hypnotic purposes, and given orders not to administer it unless necessary.

The giving of a placebo, in the shape of a sugar capsule or sterile water hypodermic, is sometimes resorted to when other means of breaking the patient of the use of a narcotic have failed. To decide upon doing so is not the nurse's function. The most difficult patient to break is the one whose insomnia has been the result of pain. His dread of its recurrence will often lead him to feign pain in order to procure what will prevent its return.

A patient's own account of his sleep should neither be disregarded nor receive implicit credence; nor should his own account ever be contradicted in a report given in the patient's hearing. Great pains should be taken to measure both sleeping and waking intervals by the clock, and to record both accurately on the chart. Broken sleep is not restful. On a report, for example, "sleep, four hours" should mean only four hours' *consecutive* sleep. If the four hours is the total sum of many short sleeps, with restless intervals between, the record chart should state the fact clearly.

Chronic insomnia occurring in health is one of the most

intractable of conditions to cure. It is most commonly due to mental conditions, such as brain fatigue or persistent worry; it may result from injudicious use of tea or coffee, the alcohol habit, deficient hygiene, sedentary habits, or lack of outdoor exercise. Many cases are referred directly to eye-strain. Insomnia is a frequent accompaniment to habitual constipation.

Where the cause is known, the first step is to remove or alleviate the cause. In many cases, however, the habit once formed tends to persist. The general health should receive close attention, and the habits regulated to include fresh air and a reasonable amount of exercise. Coffee and tea should be given up or taken only in the early hours of the day, and the use of alcohol restricted or forbidden. Frequently, stopping all brain work, even pleasurable brain work, at an early hour in the afternoon has a beneficial result. The effect of a light meal in place of the heavier dinner at night should be tried.

At bedtime means are used which have for their object the reduction of the blood-supply in the brain. An anemic brain will sleep. Heat to the extremities and cold to the head are the usual means. A hot tub-bath or hot foot-bath, hot-water bags to the feet or over the abdomen, with an ice-bag or bag of ice water to the head, are simple means. The cold bag should be placed at the back of the neck and side of the head. A light meal, a cup of warm milk, or hot whisky toddy may, in milder cases, be sufficient to divert the blood from the head to the stomach and induce sleep. Other means are massage, either general or to the spine and head, and the wet pack. In very overwrought conditions the wet pack is usually the best immediate treatment.

Acute insomnia in health is frequently seen as the result of abnormal mental effort or acute business worry. The best treatment is complete change of scene and occupation. When this is impossible, the amount of mental work should be reduced to a minimum, and the health and habits carefully regulated; of the means of immediate treatment, the wet pack is generally the most beneficial.

Insomnia in a child is usually due to a mental condition,

and always an important symptom. Women are more prone to insomnia than men. Aged people are wakeful, but, as a rule, they do not suffer from the effects of loss of sleep.

When it becomes necessary to employ drugs for insomnia, the ease with which the narcotic habit is formed should never be lost sight of. It should never be begun without medical advice nor continued away from medical supervision. The excitable temperament most liable to insomnia is liable to be deficient in self-control.

PARALYSIS

By paralysis we usually understand a loss of the power of movement, usually also accompanied by loss of sensation, not due to local impairment, but to disturbance of the nerve-centers that govern movement. This disturbance may be due to disease, to direct injury, or to pressure.

With our complex nervous system, the varieties of paralysis are numerous. We find a special lesion in some special part of the brain or spinal cord, followed by special symptoms of impairment of power and nutrition in special groups of muscles. In many cases the group of symptoms are classed as a disease and known by the name of the observer or authority who originally called attention to the special manifestations. A large number of these forms of paralysis are the result of changes due to incurable disease and develop very slowly.

Paralysis may affect one entire side of the body (*hemiplegia*), or the whole body below a certain point in the spine (*paraplegia*); paralysis may also be strictly local, affecting one limb or a special group of muscles, as in facial paralysis.

Hemiplegia.—In hemiplegia the lesion is in the brain, in paraplegia the spinal cord is the seat of injury.

Hemiplegia is most commonly the result of an *apoplexy* or cerebral hemorrhage, and begins with an acute condition of unconsciousness, stertorous breathing, etc.; it may also result from disease of the brain tissue, embolism, or pressure on the brain from a tumor or depressed fracture of the skull (p. 624).

In a typical case of apoplexy, the patient falls to the ground in an unconscious condition, the respirations are stertorous, the pulse full and slow, the face congested and somewhat cyanosed; the eyes are half open and the pupils do not react to light. There may be twitching of the muscles or epileptiform convulsions. The temperature is first subnormal and later usually raised.

As the acute symptoms subside, the patient is found to have no power on one side of his body. In some conditions sensation is not lost, in others there is either complete or partial anesthesia. With some rare exceptions the paralysis is on the opposite side to the injury, owing to the fact that the nerves cross at the part of the brain known as the *pons*, so that the nerve-center that governs the movement of a muscle is situated in a portion of the brain on the opposite side from the muscle it governs. In hemiplegia of the right side of the body the organ of speech is usually affected.

Recovery in hemiplegia follows removal of pressure, in some conditions from surgical intervention, usually from gradual absorption of the blood-clot. Where the hemorrhage has been due to arterial degeneration, apoplexy is very liable to recur, and eventually to prove fatal. After several attacks, or where the injury has been extensive, hemiplegia usually results in impairment of the mental faculties: loss of memory, mental sluggishness, and aphasia are common effects.

Paraplegia, or paralysis of the lower extremities and lower part of the trunk, is the result of injury or disease involving the spinal cord. Occurring suddenly, the most frequent cause is fracture or dislocation of the spine (p. 629). The motor and the sensory nerves are both paralyzed, and the bladder and rectum involved. Unless the injury has also caused concussion or other brain condition, the mind is clear.

Paralysis occurs below the seat of lesion; when this is so high as to involve the muscles of respiration, death occurs from asphyxia. Cases of mild injury recover completely, others live years with the body paralyzed from the waist downward. Severe injuries are usually fatal: the

patient lingers a few months and finally dies of exhaustion or one or other of the complications of the condition.

Special forms of paralysis frequently met with are infantile paralysis and facial paralysis. Infantile paralysis, *acute anterior poliomyelitis*, affects certain groups of muscles in the lower extremities, and is due to alterations in a minute portion of the spinal cord. Facial paralysis is an affection of the nerve-endings, generally due to inflammation of the periphery, sometimes from such a trifling cause as sleeping in a draught. The condition may also be the result of pressure on some part of the nerve, from which reason it is sometimes present as a temporary condition after operations on the mastoid.

EDEMA

Edema is a swelling due to the accumulation of fluid in the tissues. It may be caused by local inflammation, as in contused wounds. When it is a simple infiltration of fluid from the blood-vessels, unattended by inflammation, it is known as *dropsy*.

Dropsy.—The characteristic appearance of dropsy is a puffy, colorless swelling which pits on pressure. That is to say, if the finger is pressed over the surface a depression is made which persists for an appreciable time. The skin has a waxy hue, and when the dropsy is excessive, a stretched, shiny appearance.

The fluid in dropsy is derived directly from the circulation. It may be forced out through the walls of the capillaries by the pressure of a venous obstruction, or may result from changes in the capillary vessels themselves, or from alteration in the composition of the blood. The most common conditions associated with dropsy are nephritis, chronic valvular heart disease, and anemia. A local dropsy, *i. e.*, confined to one limb, is most commonly the result of a thrombus. It may also be produced by any condition causing pressure, such as a tumor, or prolonged mechanical constriction, as in tight bandaging.

The dropsy in *nephritis* first appears about the eyes, and is most noticeable on first waking, and on the side on which

the patient has been lying. In *heart disease* the dropsy first appears about the feet and ankles, and gradually ascends. The dropsy of anemia is usually confined to a puffiness of the feet and ankles, observed at the end of the day and improved by the night's rest.

The term dropsy is also used for accumulations of fluid in the cavities of the body, as, for example, the pericardium or the abdomen. The fluid is confined to the cavity and does not infiltrate the tissues in the vicinity. Fluid in the abdomen is called *ascites;* a condition of general dropsy is called *anasarca.*

The condition of dropsy is treated principally through the underlying cause of the dropsy. Active elimination by the bowels and kidneys, and, where the kidneys are impaired, increased elimination by the skin are the principal points of general treatment. In conditions of extensive dropsy saline purgatives are frequently ordered in strongly concentrated solutions. As a rule, fluids are restricted in the diet, but this depends on the underlying cause. (See Salt-free Diet, Chap. XXIII.)

For the local treatment of dropsy, see Paracentesis, p. 518.

Where drugs with accumulative properties are being taken by dropsical patients, it should be borne in mind that a sudden withdrawal of the fluid may be followed by symptoms of overdose of such drugs (p. 306). The drug, to a large extent, it is considered, has been held in suspension in the excessive fluid, and becomes suddenly set free in the system. This is especially the case with digitalis, which, both as a heart tonic and as a diuretic, is largely used in the treatment of heart disease and nephritis.

VOMITING OR EMESIS

This is a forcible ejection of the contents of the stomach.

The **causes** of vomiting may be *local* or *remote.* Local causes are those that arise from disturbance of the function of the stomach. The most common are indigestion, catarrh or disease of the stomach, the action of certain irritants, such as mustard or zinc, known as emetics; the

action of corrosive and irritant poisons, and obstruction at some part of the alimentary tract.

Remote causes are those that produce vomiting by irritation, direct or reflex, of the central nervous system. Vomiting due to nerve irritation is described as *central vomiting*. Common causes of central vomiting are: disease of the brain, pressure on the brain from a tumor or injury; the presence of toxins in the blood as in uremia, the invasion of the system by an acute infection; the action of certain drugs, such as apomorphin or ipecacuanha, known as central emetics, the toxic action of many drugs, especially nerve depressants; violent swinging, as in seasickness; and reflex irritation, as in pregnancy, worms, etc. Reflex vomiting may be excited by tickling the back of the throat or by strong unpleasant odors and tastes. Central vomiting occurring in conditions of shock shows a return of vitality in the nerve-centers, and is considered a favorable sign.

Regurgitation is the simplest form of vomiting. It consists in the rejection of some of the contents of the stomach before digestion has taken place. It occurs commonly in infants, from too rapid feeding. Occurring as a constant symptom after small quantities only have been taken, it is frequently caused by stricture of the esophagus. The appearance and odor of regurgitated food are not changed.

An attack of vomiting is usually preceded by headache, nausea, and local discomfort, either pain or distention, and accompanied by retching and eructation of gas. If the stomach is loaded, the contents are vomited in a partially digested condition. If the stomach is empty, as after a previous attack of vomiting, the vomitus is usually small in quantity, greenish yellow, viscid, and with a bitter taste, owing to the presence of bile. This is the ordinary attack of vomiting, due to a large variety of causes—gastric disturbances, the so-called bilious attack, sea-sickness, intestinal obstruction, the after-effects of an anesthetic, etc. The attack is followed by a sensation of relief and relaxation.

Treatment.—If a patient is unconscious, it is important

to keep the head turned to one side, so that the vomitus does not enter the larynx. A patient in an extreme condition of exhaustion should not be allowed to sit up or raise the head; the vomitus should be received on a towel or in a shallow vessel.

Persistent vomiting is difficult to control. All food should be withheld, the recumbent position maintained, and bright light or moving objects excluded. Counter-irritants, such as a mustard plaster, hot fomentations, or a small blister, over the stomach, together with an ice-bag to the head, may have the desired effect; or an ice-bag may be applied over the stomach. In many cases lavage gives relief. The lavage may be of plain warm water, or contain bicarbonate of soda, to counteract the acidity of the stomach. The drinking of one or two pints of warm water will usually act as lavage without the necessity of passing the stomach-tube. In some cases the inhalation of vinegar gives relief. As a rule, the head should be kept low; in a few instances elevation of the head of the bed has had a beneficial result.

When the cause is an error in diet, lavage, followed by a purge, such as castor oil, is often the quickest remedy. Where the castor oil cannot be retained, an enema may be given.

Cracked ice to suck or brandy or champagne poured over crushed ice and given in sips are usually acceptable remedies. Drugs frequently prescribed for the condition are morphin by hypodermic ($\frac{1}{12}$ to $\frac{1}{8}$ grain), opium, usually by suppository ($\frac{1}{2}$ to 1 grain), cocain ($\frac{1}{8}$ grain), astringents, such as bismuth subnitrate (10 grains), cerium oxalate (5 grains, given dry on the tongue), hydrochloric acid *diluted* (5 to 10 minims), and others. In some instances obstinate vomiting has been checked by 1-minim doses of carbolic acid in water.

If sleep can be induced, the attack frequently passes off. A cleansing, non-nauseating mouth-wash should be given to rinse the mouth.

Vomiting occurring regularly on rising in the morning is a common symptom during the early months of pregnancy. It is unaccompanied by nausea, headache, or

retching. The vomitus usually consists of a little mucus. It may often be prevented by drinking a cup of tea before moving.

Mucous vomiting on rising is also a common symptom in chronic alcoholic gastritis.

For abnormal constituents in the vomitus, see Chap. VII.

HICCUP; SINGULTUS

The spasmodic inspirations known as hiccup are caused by a spasm of the diaphragm accompanied at the same time by spasm of the glottis.

In health an attack of hiccup is the result of minor causes, such as slight gastric disturbance from overacidity, from bolting the food, or from energetic exercise too soon after eating. The spasms may usually be overcome by drinking water, either alone or with a little sugar or bicarbonate of soda, or by holding the breath and so keeping the diaphragm and glottis immovable for a time.

Attacks of hiccup occurring in the course of disease are usually significant and often difficult to treat. When associated with conditions of shock or collapse, hiccup is a symptom of serious exhaustion. In certain conditions attacks of hiccup occur from reflex irritation, these may be: disease of any part of the alimentary tract, pressure from an aneurysm, toxic conditions, such as uremia, nervous disorders, and in conditions caused by pressure on the brain; intractable hiccup is not infrequently met with in hysteria.

The spasm if long continued is extremely exhausting. The usual remedies tried are hot applications or counter-irritants applied over the abdomen; hot whisky and water by mouth; or emptying the stomach by an emetic or lavage. Antispasmodics may be effective; those usually prescribed are musk, Hoffmann's anodyne, or camphor. Sedatives or narcotics are given to induce sleep; chloroform inhalations and morphin are used in extreme cases.

Frequently no treatment has any lasting effect. A special movement in massage is sometimes followed by good results. The fingers are placed over the ribs on

either side, so that the thumbs meet at the sternum. Rhythmic strokes are then made with the thumbs from the sternum downward and toward the sides, following the line of the margin of the ribs. The treatment is chiefly valuable in hysterical hiccup.

CONSTIPATION

Constipation is the most common of minor disorders, either in health or disease. It may be acute or chronic.

Acute constipation is usually due to an error in diet, sudden alteration in normal habits, or changes of climate. It is generally most quickly relieved by a dose of castor oil, or a course of calomel followed by sulphate of magnesia, and subsequent attention to diet and hygiene.

The tendency to chronic constipation is frequently hereditary. It may be acquired by careless habits, sedentary occupations, or injudicious diet. Other causes are nervous strain, overfatigue, and the alcohol habit.

Physical symptoms that accompany constipation are headache, loss of appetite, nervous irritability, and sluggishness of mind and body. If allowed to become habitual, constipation is liable to result in the formation of hemorrhoids, anal fissures, or in intestinal obstruction from fecal impaction.

Treatment.—The condition should be regarded as a menace to health and not allowed to continue.

The formation of a punctual habit, combined with tonic measures, such as cold bathing and regular exercise, will frequently, if persevered in, cure even obstinate cases. The diet should be studied to ascertain the food best suited to the individual. Whole wheat bread, oatmeal, and fruit, particularly cooked fruit, are mildly laxative (Chap. XXIII). The meals should be taken at regular hours and eating between meals discouraged. Water, either hot or cold, should be drunk regularly, and is especially beneficial taken at bedtime or on first rising. A general tonic, such as strychnin, will frequently benefit the condition. Good hygiene and warm clothing, especially woolen wear next the abdomen and for the feet, are important factors, and particularly so with children.

The constipation may be largely due to weak muscular action, and chiefly affect the lower bowel. In these cases a simple enema or a suppository of soap or glycerin are generally effective, and their use for a short time may help to establish a regular habit, especially in young children. Their persistent use, however, has an irritating effect on the local mucous membranes, and may lead to the formation of fissures.

When drugs become necessary, they must be used with caution, and discontinued as soon as possible, as the system quickly comes to rely on them. Mild drugs are to be preferred to drastic purges. Many cases of obstinate constipation are benefited by regular abdominal massage. It should be given punctually at the same hour every day. When an expert masseuse is not procurable, the massage may be efficiently performed with a cricket ball or baseball. Placed over the lower part of the abdomen to the right, the ball is carried slowly upward, with a rotatory movement of the palm of the hand, then across the abdomen, and, finally, down on the left side, the movements following the direction of the colon. The pressure should be firm and even, but not forcible; the process is usually prescribed for about ten minutes at some time when the intestines are at rest, preferably in the morning.

Constipation is a common accompaniment to many diseases, especially those that interfere with the process of nutrition or, from whatever cause, obstruct the secretion of the digestive juices. It is present in many forms of gastritis, enteritis, cancer of the stomach and intestines, jaundice, and pancreatic disease; in brain affections and nervous conditions; in anemia; and commonly in the acute infectious fevers. In many of these conditions the stools have a characteristic appearance. (See Excreta.)

DIARRHEA

By diarrhea is understood an abnormal frequency of the stools, with a change in their character and consistency. (See Excreta.)

Commonly, it is an **acute** condition associated with inflammation of some part of the alimentary tract. It is

symptomatic of the water-borne infections, typhoid fever, dysentery, and cholera; it is common in all forms of gastritis or enteritis, both acute and chronic, and may be associated with chronic constipation; it accompanies acutely septic conditions, and is usually a symptom at the close of long, wasting illnesses; an attack of diarrhea is also a common accompaniment of the crisis of an infectious fever, such as pneumonia.

The **chronic form** of diarrhea is commonly associated with chronic dyspepsia. Persons who have suffered formerly from typhoid fever or dysentery are subject to attacks of diarrhea from trifling causes or in any lowered condition of health.

In nervous persons acute diarrhea may result from excitement or strong emotion.

Physical symptoms that accompany an acute attack of diarrhea are nausea, frequently vomiting, abdominal cramps, distention, straining (tenesmus), loss of appetite, and thirst; slight fever is not uncommon; on the other hand, the temperature may be subnormal.

The first **treatment** of an acute attack, not associated with a specific disease, is to clear the alimentary tract by a quickly acting purgative, in order to get rid of the source of irritation. Castor oil is usually preferred. If not effectual in two or three hours, it is followed by a simple enema. After one or two actions from the castor oil, the diarrhea, in favorable cases, is checked; if not, astringents, such as bismuth subnitrate (10 to 20 grains), are usually ordered, repeated every three or four hours until effectual, or opium in some form may be given (usually paregoric, 2 to 4 drams, or tincture of opium, 10 to 20 minims; the dose may be repeated once). Brandy, taken raw (1 to 2 drams), has frequently a beneficial effect. Meantime solid food should not be taken. The after-treatment of the condition is chiefly dietary. (See Chap. XXIII.) Fatigue and exposure to cold, damp, or to sudden changes of temperature must be avoided; frequently a short time in bed is the quickest remedy.

Diarrhea in infants is always an important symptom, and may quickly become a very serious condition. It may

result from injudicious feeding, sour or impure milk, dirty feeding bottles, from cold or wet feet, or from exposure to high atmospheric temperature. It is a common disorder in the summer months, particularly with bottle-fed babies. It is also the accompaniment of all acute infections of the alimentary tract to which infants, especially neglected and bottle-fed infants, are liable.

Unless treatment is prompt, the condition may be fatal. The first treatment aims at removing the irritating cause, usually with a purge (unless in infectious conditions, where special treatment is necessary), following which the treatment is largely dietary (Chap. XXIII). If the condition persists, astringent enteroclysis is frequently ordered.

RIGOR

An acute paroxysm of shivering is known as a *rigor* or *chill.* In severe cases the shivering is accompanied by the sensation of intense cold, especially referred to the back and spine; the surface is cold to the touch, the teeth chatter, the features are blue and pinched, the pulse is small, hard, and rapid, and the vitality greatly depressed. The paroxysm may be so violent that the bed on which the patient lies is actually shaken. The temperature for a short time is subnormal, but rapidly rises. The attack lasts from a few minutes to half an hour or more. In cases of malaria the characteristic rigor frequently lasts an hour.

A short time after the shivering has stopped, a rigor is followed by a hot stage, the characteristic symptoms of which are high temperature, full, bounding pulse, headache, a hot dry skin, and other evidences of fever.

A rigor always has a definite signification. It is the usual accompaniment of the onset of all infectious fevers that begin abruptly, such as pneumonia, erysipelas, etc.; of all septic conditions, especially when accompanied by suppuration, and is the characteristic symptom of the first stage of an attack of malaria. Occurring in connection with an open wound, as after an operation, or in the course of an acute illness, a rigor indicates some suppurative process. In all intermittent fevers (see Fever) the rise of temperature is usually accompanied by rigors of

more or less severity. In these cases the hot stage, which may last but a short time or for several hours, is followed by a stage of sweating in which the temperature again falls.

Not infrequently prolonged or difficult catheterization is followed by a rigor and rise in temperature. The rigor may be purely nervous in its origin, in which case the temperature does not remain high and the acute symptoms quickly subside. More often the rigor indicates infection from a non-sterile catheter, unclean hands, etc., and ushers in an attack of septic cystitis. A nervous chill may follow an accident or severe strain. Although frequently quite severe, it is not followed by any marked rise in temperature or other symptoms of fever.

As a rule, children do not have rigors. Conditions that in an adult would be associated with rigor, in a child are usually accompanied by convulsions.

The **treatment** of a rigor is the application of warmth—warm coverings, hot-water bottle, and hot drinks. Frequently stimulation, such as hot whisky and water, is ordered. The patient should be kept in bed and carefully protected from draughts. The hot stage is treated with light covering, an ice-bag to the head, and plenty of water to drink. The pulse, and, where practical, the temperature, should be taken at the beginning of a rigor, immediately after, and again in half an hour's time. The duration of the rigor, the pulse and temperature, and any other prominent symptoms should be carefully recorded on the chart.

SWEATING

An attack of profuse sweating, or *diaphoresis*, is the common feature of any crisis following a period of high temperature. (See Crisis.) In such condition it is a favorable sign, and is accompanied by a fall of temperature and a general condition of improvement. A typical example of a favorable diaphoresis is the profuse sweating in the third stage of a malarial paroxysm.

Accompanying a condition of profoundly lowered vitality or general collapse, with clammy skin, cold extremities, and small feeble pulse, sweating is an unfavorable symptom. It may be associated with a high or a subnormal tem-

perature. Such a condition is frequently seen shortly before death.

Severe sweating, usually occurring at night, is a common feature of enfeebled conditions associated with hectic fever, such as the later stages of tuberculosis and septicemia.

Periodic attacks of sweating are a common symptom in acute inflammatory rheumatism; the sweat is peculiarly acid and has a characteristic sour smell. Attacks of sweating are also a characteristic accompaniment of the convulsions of tetanus.

Sweating may also be produced by great pain or by emotion, especially fear. In the latter case it is preceded by the creeping sensation known as *goose-flesh*, due to the contraction of the minute muscles attached to the roots of the hair.

Sweating may be induced artificially by the application of external heat, such as the sweat-bath, hot pack, etc. (Chap. II), and by the action of certain drugs known as diaphoretics.

The **treatment of sweating** lies in keeping the patient warm, dry, and protected from exposure to chill or drafts. While the sweating continues, he should be closely covered, preferably with material that will absorb the sweat, such as flannel or blankets. If a cotton shirt is worn, it is best to remove it at once, as when wet it has a chilling effect. When the sweating ceases, the skin should be quickly dried with hot towels, and the wet clothing changed, the whole process being carried out strictly under cover. A brisk alcohol rub may be added where practical, and will help to check a continuance of the sweating.

The sweating of tuberculosis is reduced by methods that reduce the fever, especially sleeping and living in the open air. To some extent tepid or astringent sponging, such as vinegar and water, has a beneficial effect on the sweating of feverish conditions. The bed-coverings should not be heavy; if necessary, warmth may be supplied by the hot-water bag or the use of woolen socks.

The sweating of rheumatic fever is frequently indirectly treated by hydrotherapeutic measures, such as cold bathing or sponging. The patient should sleep between blan-

kets and wear a flannel shirt. To remove the disagreeable odor of the sour perspiration, sponging with hot water or hot water and vinegar is generally practised. It must not be begun until the diaphoresis is completely over.

Certain drugs have the property of checking sweating (anhydrotics); that in most general use is belladonna, with its alkaloid, atropin.

Unilateral sweating, or sweating confined to one side of the face, is a phenomenon that occurs from pressure on certain nerves of the sympathetic system, either from a thoracic aneurysm or other tumor.

Sudamen.—A peculiarly pretty eruption of minute, pearly vesicles is known as *sudamen.* It consists of fine beads of perspiration that have become imprisoned in the upper layer of the skin. It is usually seen in connection with free perspiration. The condition requires no treatment; the vesicles dry up, leaving a superficial desquamation.

FEVER

A condition in which the body temperature is raised above 100° F. is said to be one of fever. A raised temperature is a common feature of many physical disturbances (see Temperature). By the term fever in its more restricted sense we understand a condition in which the temperature is persistently raised for certain defined periods, the rise being associated with a group of characteristic physical symptoms.

The **cause** of fever in the majority of cases is attributed to the presence in the blood of *toxins* or poisons (Chap. XI), usually the production of bacterial activity. These are the so-called infectious fevers, such as typhoid fever, smallpox, malaria, and others. In other cases the toxins are substances produced by the natural activity of the body, which, owing to defective elimination, have entered the circulation. Such are the toxins in uremia or in auto-intoxication. A fever not due to infection, but the result of overfatigue, gastric disturbances, exposure to heat, etc., is known as simple continued fever. Conditions in which the

secretions of the body are abruptly checked are also associated with fever. A mild example is the fever attending the common "cold"; a grave example, the high fever of heat-stroke.

The **physical symptoms** that accompany fever are—malaise, chilliness, headache, nausea, loss of appetite, thirst, constipation (or, less frequently, diarrhea), and coated tongue. The pulse is full and bounding; both pulse and respiration are quickened in proportion to the rise of temperature (see Temperature). The skin is hot and dry, the face flushed, the mouth parched, the urine scanty and concentrated, and frequently albuminous; the patient is restless and sleep is disturbed. When fever begins abruptly, the chilliness may be severe and takes the form of *rigors*. As already said, in children convulsions usually take the place of rigors. An abrupt onset in children is usually also characterized by a sudden attack of vomiting.

As the fever progresses, further symptoms are prostration, emaciation, and nervous symptoms—insomnia, startling dreams, and, in severe cases, delirium or coma. The coated tongue has a tendency to become heavily furred, dry, and fissured.

The symptoms that mark the beginning of a fever are called *prodromes*. The most common are malaise, chilliness, headache, loss of appetite, gastric disturbance and restlessness, and, in children, vomiting. It is to the prodromes we refer when we talk of a person "sickening" for an illness. In many of the specific fevers there are characteristic prodromes. For example, in measles there is a characteristic coryza; in scarlet fever, soreness of the throat; in smallpox, agonizing pain in the back and limbs.

Course.—A fever is divided into three periods: the *invasion* or *onset*, the *fastigium*, also called the *stadium*, and the *decline* (p. 157). In the specific fevers the average length of duration of each period varies within the different infections. During the *invasion* period the temperature rises and the characteristic symptoms gradually develop; during the *fastigium* the temperature remains at or near its highest point, with certain variations in each twenty-four

hours; the symptoms are intensified, especially the nervous symptoms, and emaciation, which progresses rapidly. During the period of *decline* the temperature falls until the normal is regained; in favorable cases all the symptoms improve. The skin begins to act naturally, the urine is increased in quantity, the bowels are less constipated, some diarrhea is frequently present, sleep is natural, the tongue becomes moist and clean, and the mental condition improves. During the decline, prostration is a prominent symptom; it is especially at this time that, unless carefully supported, the overtaxed heart may fail.

In some fevers the invasion is *abrupt,* the temperature rising rapidly in a few hours to a considerable height, in others the rise is slow, the temperature rising and falling from day to day, but each daily scale of temperature being higher than that of the preceeding twenty-four hours. The invasion is then described as *gradual.* A decline occurring abruptly is called a *crisis;* occurring gradually, a *lysis.* Only a few fevers commonly terminate by crisis. They are pneumonia, measles, typhus fever, erysipelas, malaria, relapsing fever, and, frequently, influenza.

A crisis is accompanied by marked characteristic symptoms. They are profuse perspiration, a large increase in the quantity of urine, frequently diarrhea, sensations of chilliness or shivering, unless the body is well protected. Some prostration is always present, and there is risk of sudden cardiac failure. In favorable cases the patient falls into a natural sleep and awakens refreshed.

At the end of the decline *convalescence* is established. Daily variations in the temperature are known as *remissions* (see Temperature). Where the remissions are slight, not more than a degree to a degree and a half, the fever is said to be *continued.* Where the remissions are greater, but where the whole scale of temperatures is entirely above normal, that is to say, fever is always present, the fever is said to be *remittent.* A few characteristic paroxysms of high temperature followed by remissions, in which the temperature falls to normal or subnormal, is described as *intermittent;* that is to say, in an intermittent fever there is a period in which there is *no* fever. This period may be

a daily remission, lasting a few hours, as in many forms of septicemia, or it may occur after a short, acute access of fever and last for one or more days, as in the different forms of malaria; or again, a period of continued fever, lasting several days, may be followed by an intermission of several days, as in relapsing fever. In intermittent fever the characteristic symptoms of invasion, fastigium, and decline are present in an aggravated form and follow each other with great rapidity. Then, as the fever rises, we have an acute attack of shivering, followed quickly by the flushed face, hot skin, full pulse, high temperature, and other symptoms of the fastigium. The decline occurs as a crisis, with profuse sweating, increased urine, exhaustion, and a disposition to sleep.

The fever, during a gradual invasion and toward the end of a lysis, is commonly remittent. During the fastigium it is generally continued. In fevers beginning abruptly and ending by crisis, such as pneumonia or typhus fever, the fever is continuous during the whole course of the disease. In typhoid fever, as a rule, the fever is remittent not only during the invasion and lysis, but also during the fastigium. Remittent fever lasting three weeks is one of the diagnostic symptoms of the disease. In acutely septic conditions, associated with the formation of pus, intermittent fever is common.

Fevers that do not belong definitely to either class, but may evince in their course the characteristics of two or all three, are described as *irregular*. The fever in tetanus, and frequently in diphtheria, is irregular.

Long, protracted fever is sometimes called *hectic;* as a rule, it is of the intermittent variety. It is common in septic conditions and generally accompanies the last stages of tuberculosis.

Incubation Period.—In the specific infectious fevers the period occurring between the exposure to infection and the beginning of the invasion is known as the incubation period.

Duration of Periods.—The table on p. 712 gives the average duration of the different periods in the more common infectious fevers.

	Incubation.	Invasion.	Fastigium.	Decline.
Chicken-pox	About two weeks.	Abrupt.	One to three days.	Lysis generally rapid.
Diphtheria	A day to a week.	Usually gradual or moderately abrupt.	Variable.	Lysis.
Erysipelas	Three days to a week.	Usually abrupt.	Variable. Favorable cases a week to ten days.	Crisis.
German measles	About two weeks.	Gradual; one or two days.	One to three days.	Lysis; rapid; a few days.
Influenza	A few days to a week.	Abrupt.	Two to four days.	Lysis or crisis.
Measles	Usually two weeks.	Gradual; about four days.	Two to four days.	Crisis.
Mumps	Two to three weeks.	Gradual; one or two days.	Three to six days.	Lysis; a few days.
Pneumonia, lobar	....	Abrupt.	Five, seven, or nine days; occasionally fourteen days.	Crisis.
Scarlet fever	A few hours to one week.	Abrupt.	Two to four days.	Lysis; four to six days.
Septicemia	Usually three days.	Abrupt.	Indefinite.	Lysis.
Smallpox	Ten days to two weeks.	Abrupt.	About eighteen days.	Lysis.
Tetanus	A few days to three or four weeks.	Gradual.	Variable. A few days to several weeks.	Lysis.
Typhoid fever	Two to three weeks.	Gradual; seven to ten days.	One to two weeks.	Lysis; a week or ten days.
Typhus fever	A few hours to two weeks.	Abrupt.	Twelve to fourteen days.	Crisis.

ERUPTIVE FEVERS

Certain acute infectious fevers are characterized by the presence of a skin eruption or rash; they are classed as the eruptive or exanthematous fevers. In each case the rash presents a characteristic appearance. It is usually first observed over some special area, appears on a certain day of the disease, and is followed by a more or less extensive shedding of the upper layer of the skin, a process known as *desquamation*. The shed particles should be regarded as infectious. Desquamation is described as *branny* (a powdery shedding of the surface skin), or may occur in *scales*, *flakes*, or *crusts*.

The first day of disease is taken as the first day of abnormal symptoms, such as shivering, vomiting, malaise, and rise of temperature.

Varicella, or Chicken-pox.—*Rash* appears on the first day of the disease.

Character.—Rose-red papules which, except in mild cases, rapidly become vesicular. Intense itching is usually present.

Distribution.—The rash appears simultaneously all over the body, coming out in groups. The vesicles are superficial, become pustules, and dry up in two or three days. The cuticle is shed in the form of thin crusts, considered moderately infectious.

Infection is considered to last until the crusts have all been removed and the skin is entirely healed.

Scarlet Fever.—*Rash* appears on the second day of the disease, that is to say, between twenty-four and forty-eight hours.

Character.—Diffuse, scarlet (erythematous), punctiform eruption, effaced by pressure. A quick stroke with the finger across the rash will leave a white line lasting several moments.

Distribution.—The rash appears first on the chest and neck and rapidly covers the whole body. The whole face is involved, except an area round the nose and mouth, which remains pallid; the rash lasts from five to seven days, gradually fading, and followed by profuse *flaky desquama-*

tion, the particles of which are considered extremely infectious.

Infection lasts until the desquamation has entirely ceased—usually from six to eight weeks. Infection will last beyond this period if there should be discharges from nose, ears, or suppurating glands.

The scarlet-fever rash is typical of many other rashes caused by accidental conditions (Chap. VI); the expression *scarlatinous* rash is frequently used to describe them. The association of scarlet fever with special physical symptoms, in particular with acute sore throat, and a characteristic appearance of the tongue, known as the *strawberry tongue,* and the characteristic distribution of the rash confirms the diagnosis.

Smallpox.—*Rash* appears on the third day of the disease.

Character.—Small, round, red papules, feeling like shot beneath the skin, which develop into vesicles and finally become pustular. Papules, vesicles, and pustules (p. 206 may be seen together on small areas. As the rash appears the temperature usually falls somewhat and rises again as the rash becomes pustular, about the eighth day. When the eruption is so copious that the papules run together, the rash is said to be *confluent.*

Distribution.—The eruption occurs first on the forehead, face, and wrists, finally involving the whole body.

Desquamation occurs in scales with a peculiar offensive odor, each scab leaving behind a pit or pock which remains for a long time after the spot is healed and may be permanent.

Infection is considered to continue until the skin is entirely healed.

Measles (Rubeola).—*Rash* appears on the fourth day of the disease.

Character.—Macular and papular spots (p. 206), dark red in color, and usually occurring in groups forming a crescent.

Distribution.—The rash appears first on the face, usually the forehead, and spreads rapidly over the body. It fades in from three to four days, followed by branny desquamation. Itching is a frequent symptom. A few small,

bluish-white specks, scattered on the mucous membrane of the cheeks and lips, may frequently be observed before the rash develops. They are known as *Koplik's spots.* The acute catarrhal condition of the nose and eyes which accompanies the onset of the disease confirms the diagnosis.

Infection lasts until the skin is quite free from desquamation or until all discharge from the ears or nose has stopped.

German Measles (Rubella or Roseola).—*Rash* appears on the first or second day of the disease.

Character.—It may resemble either the papular rash of measles or the diffuse, bright-red rash of scarlet fever.

Distribution.—It appears first on the face or behind the ears, and rapidly spreads over the body. It fades very quickly, leaving a slight branny desquamation. It is distinguished from scarlet fever or measles by the slight physical symptoms and the rapidity with which the rash fades and convalescence is established.

Typhus Fever.—*Rash* appears between the fourth and eighth days.

Character.—Petechial rash (p. 207). The spots are first rose colored, then fade to a purplish hue known as *mulberry* rash.

Distribution.—The rash occurs on the body, and is slight or diffuse, as the attack is mild or severe.

Typhoid Fever.—*Rash* appears in successive crops from the seventh to the fourteenth day.

Character.—Rose-colored, isolated, lenticular (p. 206) papules, which disappear on pressure; frequently called *typhoid spots.*

Distribution.—The papules most frequently appear in groups of two or three spots on the abdomen, but they may develop on the chest, back, or, more rarely, on the extremities. Frequently the rash is entirely absent or represented by one or two spots. Each spot forms for two or three days, and then fades. Very slight local desquamation may follow. Other physical symptoms of typhoid are usually so marked that the rash, in many instances, is of slight diagnostic importance.

OTHER SKIN ERUPTIONS

Erysipelas.—Erysipelas is classed as one of the exanthematous fevers. The rash is, however, more an acute local inflammation of the skin.

Rash appears on the first day of the disease.

Character.—The area is swollen, hard, and bright red or crimson in color, with a well-defined margin, frequently raised, beyond which the skin has its normal color. The affected surface has a glossy, polished appearance; later vesicles and blebs form, and in some cases suppuration occurs. The tissues in the vicinity are edematous.

Distribution.—It occurs at a spot in the vicinity of, though somewhat remote from, the wound through which the microbe has gained entrance. For example: in infection through a wound on the body the rash may appear on one of the extremities. In facial erysipelas the rash begins about the nose, and spreads until the whole face is involved, usually stopping short at the roots of the hair and the neck.

The rash in erysipelas lasts for four or five days, then fades, and the inflammation subsides; the desquamation may be branny or occur in flakes.

Infection is considered to continue as long as there is any desquamation.

Syphilis.—The different stages of syphilis are marked by varieties of skin eruptions, usually occurring in localized areas. In the earlier stages (secondary syphilis) the rash is commonly macular or papular, and has a characteristic dark-red color, described as ham color or coppery; subsequently the rash may become pustular and lead to superficial ulceration, or break down into *moist papules* or *mucous patches.* This occurs usually in warm, moist areas, such as beneath the breasts, under the arms, round the mouth, etc. Pustules either become reabsorbed or lead to the formation of characteristic ulcers.

In the later stages of syphilis (tertiary syphilis) *tubercles* (p. 206), *gummatous nodules,* and *blebs* filled with purulent fluid are common. A gummatous nodule is one that becomes soft or gummy in character. The eruption may dry up and become absorbed. Commonly they produce ulcera-

tion and leave behind the typical syphilitic ulcer, which has a punched-out surface, covered with thick, offensive discharge. In dressing these ulcers the greatest care must be taken or the dresser may become inoculated through any small abrasion on his own hands.

From the above it will be seen that the date of the appearance, the character and distribution of the rash, and the subsequent desquamation are all points of diagnostic importance and must be accurately noted.

Accidental Rashes.—Many conditions of acute gastric irritation, especially in children, are accompanied by a *scarlatinous* or *erythematous* rash. The physical symptoms are pronounced and the fever high. Frequently distribution of the rash begins in the vicinity of the abdomen, and the absence of acute sore throat or strawberry tongue distinguishes it from scarlet fever. An *erythematous* rash may also follow exposure to cold. Other accidental rashes are caused by poisoning by certain drugs. Atropin or belladonna produces an *erythematous* rash resembling scarlet fever, but on close examination the *punctiform* character is absent. Salicylic compounds and quinin also frequently produce an *erythematous* rash. Poisonings by many of the coal-tar products, such as antipyrin, may frequently cause a *papular* rash. The irritant poisons, such as arsenic, may produce either an *erythematous* or a *papular* rash. An *acne* rash (see below) is a characteristic symptom of bromidism and iodism. The continued use of chloral may be followed by an *erythematous* rash. A transitory *diffuse* rash, caused by the dilatation of the superficial blood-vessels, frequently appears about the neck and chest during the administration of ether.

The more common skin eruptions not associated with skin diseases are as follows:

Herpes (*fever-blister, cold sore*) appears in small groups of minute vesicles, usually about the lips. It is common in many catarrhal and feverish conditions. It is nearly always present in lobar pneumonia. The vesicles are usually treated with a simple ointment, such as oxid of zinc, and dry up and diasappear in from three to five days.

Herpes Zoster (*Shingles*).—The vesicles are distributed over the course of a superficial nerve, more commonly over one side of the body or about the face, round the eyes; the eye itself may be involved, causing intense pain. The condition is usually associated with acute neuralgic pain which is most intense before the eruption appears.

Herpes zoster is generally considered to be of nervous origin, though it may result from exposure to wet and cold, usually from wearing wet garments next the skin.

A dressing of simple ointment is first applied, and the general health attended to. The neuralgic pain is frequently relieved by phenacetin.

Urticaria (*Hives, Nettle-rash*).—The rash usually appears in successive crops, either as rose-colored papules or as white wheals on a red surface. Each crop lasts a few hours and causes intense itching. Urticaria is frequently a result of mild poisoning from shell-fish, certain acid fruits, especially strawberries, or from poisoning by poison-ivy or similar weeds. Some persons are peculiarly susceptible to the condition. To allay the itching the surface may be sponged with a solution of carbolic acid (2 per cent.) or with equal parts of alcohol and water. If due to a gastric condition, a purgative is usually administered.

Erythema Simplex, or Stomach Rash.—A simple, diffuse scarlatinous rash, not caused by a specific disease, is described as simple erythema. It may be due to gastric disturbances or poisoning by certain drugs, as mentioned above; to exposure to heat or cold, especially to sudden changes of temperature from excessive cold to excessive heat, and, not infrequently, to the effects of antitoxin.

Erythema Nodosum.—The rash appears in circumscribed, slightly raised, irregular, rose-colored patches, usually over the front of the legs. The condition is accompanied by general malaise, some fever, and rheumatic pains in the joints. It may be associated with rheumatism, gastric disorders, and malnutrition. The condition is more common in childhood.

In fading, the patches change color, turning yellow, blue, and green, like a bruise.

Local applications of lead-water or lead-water and laudanum are usually applied, and the general health is attended to, the patient remaining in bed. The condition lasts a few weeks.

Erythema Intertrigo (*Chafing*).—A local inflammation, occurring where two surfaces of the skin rub together, as in the groins, under the breasts, and between the buttocks. Cleanliness and care in keeping the places dry prevent this condition. The affected part appears first red, then moist, and, if the condition is allowed to continue, will become macerated. The surfaces should be kept apart, and a simple dressing, such as zinc ointment, applied.

Acne Rash.—An eruption of small papules frequently developing into pustules is common about the face, shoulders, and chest, especially in young girls about the age of puberty. Generally it is associated with physical debility or menstrual or gastric disorders. Small blackheads are usually present, due to occlusion of some of the sweat-ducts.

In most cases the condition is due to a parasite. The scalp should be examined, as in many instances the skin is infected from dandruff falling on the body when the hair is brushed. The use of special antiseptic ointments and lotions is usually prescribed, and attention to good hygiene and the improvement of the general health.

The various forms of skin disease are accompanied by characteristic eruptions, to recognize all of which involves a special study of the subject. The various forms of eczema are described as *papular*, *pustulous*, or *squamous*, according to the characteristics of the eruption. The following skin affections, however, may frequently be met with, especially in an out-patient department or in district work, and it is of importance that their characteristic appearance should early be recognized.

Scabies Itch.—Scabies is caused by an animal parasite, the female of which burrows under the skin in order to deposit her eggs. The line of burrowing and deposition of the eggs is marked by short, red, slightly raised dotted lines, about one-half inch in length. The accompanying line of eruption is papular, the papules frequently forming

vesicles or minute pustules. The itching is severe. The condition is highly contagious, especially through the clothing, towels, etc. Nurses in out-patient departments may frequently be exposed to this contagion. If the infection is contracted, a doctor should be consulted at once, and the greatest care exercised in disinfecting sheets, towels, etc., before sending them to the general laundry. The treatment usually advised is a hot tub-bath at bedtime, following which an ointment, generally sulphur, is well rubbed into the affected area. The doctor should be seen every few days, as the treatment itself might cause irritation to the skin.

A non-infectious eruption of red papules, intensely itching, is common in agricultural districts about harvest time. It is also due to an insect that deposits its eggs under the skin. The itching may be relieved by sponging with carbolic and water (2 per cent.) or alcohol and water (equal parts).

Pediculosis.—The bite of a louse, an insect that, in filthy conditions, inhabits the human hair, either on the head, pubes, or about the body, produces an intense itching and an appearance as of red papular rash. The discovery of the lice, and of small translucent bodies clinging to a separate hair, which are their eggs, determines the cause (p. 44). On close examination the bite of the insect can be seen in the individual papule.

Ringworm.—Tinea Tricophytina.—The eruption may occur on the head (*tinea tonsurans*), on the beard (*tinea sycosis*), or on the body (*tinea circinata*), and is caused by a vegetable parasite which attacks the roots of the hair. The form most commonly met with is the scalp ringworm among children. This ringworm consists of round, red, elevated patches; the patches at first are slightly raised, with the hair-follicles prominent; later they are grayish and scaly, and the hairs of the roots involved are dry, discolored, brittle, and easily pulled out. The center of the patch clears first, leaving the characteristic ring; the condition is highly contagious, the infection being readily carried by clothing, etc., or direct contact with the hair by another child.

The treatment usually consists in keeping the head clean by daily washing, following which the diseased hairs are pulled out and an ointment, usually of sulphur or of mercury, rubbed into the affected part. The hair of the affected parts should be either cropped close or kept closely braided to avoid coming in contact with the ringworm.

Ringworms of the body are round, scaly, reddened patches, covered with minute vesicles. The inflammation disappears first from the center, leaving the ring formation. An ointment containing mercury or sulphur is usually applied, and the clothes should be carefully disinfected and strict cleanliness observed.

Tinea favosa (favus) is a severe form of ringworm due to another form of parasite. It involves large areas of the scalp. The infected portion is covered with cup-shaped crusts, presenting an appearance somewhat like a honeycomb. The hairs are dry, brittle, and broken off short. The crusts have an offensive, musty odor. Usually the crusts are softened by poulticing or the application of warm oil, after which they are removed by washing. The treatment consists in the removal of each hair by forceps, and the daily application of an ointment containing usually sulphur or mercury. The treatment takes many weeks, but should be persevered in, or the hair may be permanently destroyed.

Impetigo Contagiosa.—An acute contagious disease of short duration, characterized by an eruption of vesicles and blebs which quickly become pustular. In a few days the blebs dry up, forming thin crusts which, on separating, leave light scars. Impetigo usually attacks young and weakly children. The eruption commonly occurs on the extremities or the face. The contagion may be carried by clothing, towels, etc., and the patient may reinfect himself by scratching.

The treatment consists in the removal of the crusts by bathing and the application of an ointment, usually of ammoniated mercury. The health is reinforced by suitable diet, good hygiene, etc.

The above are descriptions of symptoms, conditions,

and appearances associated frequently with different forms of disease, all of which are of important significance, and will be met with constantly by the nurse in her work. It is important that she should be able to recognize these conditions, to understand their general significance, and be familiar with the ordinary lines on which they are treated. To attempt further to describe the symptoms and treatment of even the most frequently encountered of the many varieties of disease the nurse will meet with is beyond the scope of a practical manual of nursing, and, moreover, is obviously the work of those especially qualified to write on the subject.

CHAPTER XXI

FOOD

Chemical Composition—Varieties of Food-stuffs—Water—Protein—Carbohydrates—Fats—Mineral Salts—Vegetable Acids—Vitamins—Condiments—Summary—Caloric Value of Foods—Calories in Diet—Value of a Mixed Diet—Digestibility of Food-stuffs—Process of Digestion—Digestive Juices and Their Action on Food-stuffs—Mechanical Process of Digestion—Absorption.

A PRACTICAL knowledge of cooking is really an essential part of a nurse's training if she is to do private nursing, and to all nurses it is an important part of their equipment, since, should she remain in hospital work, a nurse must sooner or later be prepared to superintend the choice of diets and the cooking of food-supplies for a number of people, both sick and well.

To do so effectively she must understand the basis on which foods are selected, their individual value, their economic use, and, especially in consideration of the diet of the sick, the various ways in which food can be prepared to increase its digestibility and palatableness, and to vary the monotony of a restricted diet.

By foods we understand those substances which are taken into the body for its growth, development, and the repair of its tissues. Food also keeps up the temperature of the body, and furnishes the motor power, or energy, of its activities.

It is not too much to say that nothing makes so much difference to the average human being as the food he is given; from the patient's point of view certainly no one item of his treatment touches in importance his meat and drink: what it is, how it is cooked, and in what manner it is served.

In selecting a diet a group of facts have to be considered:

1. The chemical composition of the food-stuffs.
2. Their value as energy-producers, known as the "caloric" value.
3. Their digestibility.
4. The condition of the patient's digestion. The fourth consideration will include the patient's age, physical condition, and habit of living.

To this group other considerations may frequently be necessary to add, such as whether a food is in season, the market price of food, and climatic conditions, meat and fat, for example, being required in greater quantities in a cold climate, and so forth. In the case of certain diseases also special dieting becomes necessary.

CHEMICAL COMPOSITION OF FOOD

We know that all matter, however apparently solid, is capable of being reduced into various simple component parts, which we know as *elements* or *bases*. Sugar, to take a simple example, is composed of the three elements, oxygen, hydrogen, and carbon. The nature of an element, we remember, is that it cannot be reduced to a simpler substance, or decomposed by any known force.

Complex though the body is, the cells of which it is composed are made up of various simple elements, of which the most important are oxygen, hydrogen, carbon, and nitrogen; other elements constantly present in the tissues of the body are sulphur, iron, chlorin, soda, magnesia, lime, phosphorus, etc.—in all, the body represents from 15 to 20 different chemical elements. The mineral elements are present in the body as *salts*, that is to say, in combination with an acid; thus we have *chlorid of soda, phosphate of lime, sulphate of magnesia,* and so forth. The particular combination of these elements found in living tissues is described as *organic* combination.

The body grows, develops, pursues countless activities, both functional and motor, and would, therefore, soon use up the stock of the necessary elements of which it is at birth composed; further, all activity causes some waste of the tissues. It becomes, therefore, necessary to fur-

nish the body with a continual supply of each of the above elements.

This supply is obtained from the air we breathe and the food we consume.

Value of Oxygen.—Of all the elements in the body, the most immediately important to life is *oxygen*. Deprived of oxygen, even for a few minutes, the body dies. Death from want of oxygen we call asphyxiation. Besides entering into the composition of the cell, oxygen is necessary to the body for two prime reasons:

(1) Oxygen is necessary for the process by which the prepared food is split up into its elemental parts and used by the body-cell. This process is similar to the process by which fuel is consumed in burning, and for this reason is known as *combustion*. As the process cannot take place without oxygen (any more than fuel can burn without oxygen), it is often spoken of as *oxidation*.

(2) By contact with the oxygen present in the air-cells of the lungs the blood gets rid of a poison, *carbon dioxid*, one of the products of oxidation, which, if left in the body, quickly causes death.

For the body's supply of oxygen we depend on the volume continually taken up from the atmospheric air by the blood circulating in the walls of the air-cells of the lungs.

For all the other essential elements we depend upon our food-stuffs.

It is obvious that food, as we see it, does not, except in a very few instances, such as water and common salt, suggest in its appearance the elements of which it is composed; in order, then, to supply the body with the elements it requires, and to supply them in their due proportion, it is necessary to learn what various food-stuffs contain these elements, in what proportion, and in what manner available for the body's use.

Classification.—For this purpose the food-stuffs have been classified, according to their chemical composition, in five groups:

1. Water—*hydrogen* and *oxygen*.
2. Protein—*carbon*, *hydrogen*, *oxygen*, and *nitrogen*.

3. Carbohydrates—*carbon, hydrogen,* and *oxygen,* the two last in the same proportion as in water.

4. Fat or hydrocarbon, also *carbon, hydrogen,* and *oxygen,* present as fatty acids (oleic, palmitic, stearic), in combination with glycerin as a base.

5. Mineral salts—*lime, phosphate, sodium, iron,* etc., as above.

Water.—We derive water to the greatest extent from our drinking-water, and from beverages, soups, and milk. It is also present to some extent in solid foods, as in the juice of meat, fruit, and vegetables. As an essential to the life of the body water ranks next in importance to oxygen.

Without food, but sufficiently supplied with oxygen and water and artificially protected from loss of heat, the body has been kept alive for days and even weeks at a time. Water forms about two-thirds of the entire weight of the body, and enters into the composition of every fluid and solid tissue in the body. The uses of water in the body are:

1. To regulate the body temperature.
2. To dissolve solid substances, as, for example, foodstuffs and solids in urine.
3. To dilute the blood and other fluids of the body; water is the chief part of all the secretions.
4. To dilute the poisonous products of oxidation and any accidental toxins, and to aid in their elimination.
5. It has a definite use in the process of oxidation, which cannot take place without it.

Water does not itself undergo combustion, and, therefore, does not, like other foods, supply *energy.* For these purposes, and especially as a solvent and diluent, water is more valuable in its pure state than modified as beverages, soups, etc.

Protein.—Protein enters into the composition of all animal food, such as meat, fish, eggs, milk and its products, and many vegetable foods, especially the cereals (vegetables of which we use the seeds as food, oatmeal, wheat, etc.) and legumes (vegetables of which we use the pods, as peas and beans). Such foods are often described as

proteins, or, from the fact that nitrogen is obtainable only from protein, as the *nitrogenous foods*.

Protein is divided as follows:

Albuminoids:	Albumin,	found in white of egg.
	Myosin,	" lean meat.
	Legumen,	" legumes.
	Gluten,	" cereals.
	Vitellin,	" yolk of egg.
	Caseinogen and Lactalbumin	" milk.
Gelatinoids:	Collagen,	found in skin and tendons.
	Ossein,	" bones.

The gelatinoids are of less value in the human economy than the albuminoids. They are not so readily digested, and a large proportion passes from the body unchanged. Nitrogenous foods also contain certain bodies known as *extractives*, which impart flavor to the foods and stimulate the appetite and the digestive secretions. They are without nutritive value.

The most important use of protein is for the repair of the tissues. It is the only food substance that has this property: we, therefore, conclude that some form of nitrogenous food is an absolute necessity to the body.

Whatever protein is not used for the repair of the tissues goes, in common with the other food-stuffs, to supply *energy*, in the form of *heat* and *muscular power*.

The **carbohydrates** are derived, for the greater part, from the vegetable foods, such as the cereals (wheat, oatmeal, etc.), the legumes (peas and beans), the tubers (potatoes, etc.), and the pith of certain plants (sago, etc.). Carbohydrate is present in milk as milk-sugar, and in the form of *animal starch* in oysters and other mollusks.

The carbohydrates are divided into the starches or *amyloses* and the *sugars*.

The *amyloses* include *glycogen*, or animal starch, certain soluble gummy substances, of which *dextrin* is the most important, and *cellulose*, a vegetable carbohydrate, the structural base of all plants, which cannot be utilized by the human body.

The *sugars* in food are divided into *sucroses,* or cane-sugars, and *glucoses,* or grape-sugars. Both sucroses and amyloses must be converted into glucose by the action of the digestive ferments before they can be utilized by the body. The glucoses can be absorbed without alteration.

The sucroses include—

Cane-sugar.
Beet-sugar.
Maple-sugar.
Malt-sugar (maltose).
Milk-sugar (lactose).

The glucoses include—

Grape-sugar (dextrose).
Fruit-sugar (levulose or fructose).

A mixture of equal parts of grape-sugar and fruit-sugar is called *invert sugar.* Honey is a form of invert sugar.

Sugar as food is taken in the form of the different sugars of commerce, sweet fruits, certain vegetables, such as the tomato and cucumber, and in milk (lactose).

The carbohydrates are non-nitrogenous foods, and cannot, therefore, be used in the repair of tissue in place of the proteins. Their special use is the production of *energy,* especially in the form of muscular power. What is not used for this purpose is converted into fat, and, as such, stored in the body. The carbohydrates are also stored in the body in the form of glycogen, or animal starch. It is prepared from digested carbohydrates by the liver, and stored in that organ for subsequent use. Some of the glycogen is continuously given out in the form of *dextrose* between the meals to the body, thus keeping up its supply of heat and energy. A reserve supply is also stored in the liver for use in an emergency when the body is deprived of food.

Fats or Hydrocarbons.—Fats are obtained both from the animal and the vegetable kingdoms. There are three varieties of fat, *i. e.,* solid fat (*stearin*), semisolid (*palmitin*), and liquid fat or oil (*olein*). Animal fat is found in meat,

certain fish (salmon, mackerel, herrings, and cod livers), the yolk of eggs, cream, and butter; vegetable fat in the form of oils (olive oil, cotton-seed oil), in nuts, in cocoa, and in chocolate, and, to a small extent, in the cereals and some other vegetables. Like the carbohydrates, with which, as foods, the fats are to some extent interchangeable, their use is to produce heat and muscular power and to supply the body with fat or adipose tissue. Except in the extreme north, where whale fat is one of the principal articles of diet, the carbohydrates are more largely used. They are a less expensive variety of food, and, as a rule, presented in more digestible forms. For example, nuts, while containing a highly nutritious oil, contain, at the same time, so much vegetable cellulose that they are not an easily digested food. Fat, however, is considered peculiarly necessary for the development of young tissues, where, from the natural activity of young things, and their comparatively rapid growth and development, a large proportion of protein goes actually into the repair of the tissues. The best and most easily digested form in which fat can be taken is as cream or as bacon fat.

Taken bulk for bulk, fat will produce twice the amount of energy that can be obtained from carbohydrates. Fat is also stored in the body in the form of fat, for use in emergency. In cases of starvation the body can consume its own adipose tissue, obtaining heat and muscular power from its combustion.

Mineral Salts.—The salts of the various minerals are found distributed through all the food-stuffs, both animal and vegetable. Certain food-stuffs, such as the green vegetables, are valuable almost solely for their mineral salts and contain little else of nutritive value. Some green vegetables are rich in special minerals, such as spinach, which contains an appreciable quantity of iron.

The minerals help in the building up of the tissues; certain of them, such as iron and common salt (chlorid of soda), are continually present in the blood. Lime, in the form of phosphate of lime, is the basis of all bony tissue; salt is found in all the tissues of the body, fluid and solid;

from salt the stomach prepares the hydrochloric acid of the gastric juice, thus aiding digestion. So important is this mineral to the body that, where much is lost in the cooking of food, more is added, and, in addition, salt is taken as a condiment (see below) with all heavy meals.

The mineral salts found in living material are known as organic salts; they are usually more easily assimilated than the inorganic salts.

The importance of the minerals in the human economy is appreciated when we observe the effects of a deficiency of one or other of the more important. Thus, when there is a deficiency of iron, we get the condition known as anemia, with its attendant symptoms; a deficiency of phosphate of lime causes the bones to be easily bent and deformed, the condition known as *rickets*, and so forth.

Vegetable Acids.—In connection with the mineral salts we must also consider certain vegetable acids, which, in combination with potassium, forming the salts of potash, have a very marked influence on nutrition. They are found in fruit, fresh vegetables, and in milk that has not been sterilized or evaporated (condensed milk).

Deprived entirely for any length of time of food containing one or other of these acids, a group of symptoms known as "*scurvy*" develops, which yields to treatment only when these acids are in some form replaced in the diet.

The important acids are as follows:

Lactic acid, found in milk.
Citric acid, found in lemons, oranges, limes, tomatoes, etc.
Tartaric acid, found in grapes, pineapples, etc.
Oxalic acid, found in strawberries, rhubarb, etc.
Malic acid, found in apples, pears, apricots, gooseberries, etc.
Acetic acid, found in vinegar and wine.

Some fruits contain more than one acid: Strawberries, for example, contain both oxalic and citric acid.

The flavor of both meat and vegetable foods is due to the *extractives* already mentioned, which serve as a stimulant to the appetite and to the digestive secretions. Artificially, the flavor of food is altered or increased by the use of certain adjuncts, known as *condiments*. Pepper, salt, mustard, vinegar, spices, and essences are familiar

examples of condiments constantly used to make food more palatable. Many of them (salt, mustard) also stimulate the gastric secretions, thus aiding digestion.

Vitamins.—Mineral salts and vegetable acids are classed as accessory food substances. Other important accessory food substances, recently recognized, and at present much under consideration, are known as *vitamins*. Vitamins are chemical bodies found in minute quantities in a large variety of food substances, which are proved to have a direct effect on metabolism, and especially on the growth and repair of animal tissue. Experiments show that a young animal deprived of vitamins ceases to grow; when vitamins are again introduced into the diet growth recommences. A diet deficient in vitamins disposes to nutritional disorders such as marasmus, scurvy, rickets, forms of neuritis, etc., and is considered one if not the primary cause of the tropical diseases of beriberi and pellagra. Vitamins may be destroyed by exposure to high temperature; food, therefore, prepared by processes involving high temperature are probably deprived of vitamins. Such are pasteurization, sterilization, canning, preserving, drying, desiccation, and evaporation; frequently also cooking. Vitamins are also mechanically removed in the milling of certain grains—as in polished rice, patent white flour, and cornmeal. In many proprietary baby foods the vitamins are absent. The disease of beriberi is common in districts where the inhabitants live on a diet principally of polished rice.

Milk is the most important source of vitamins in the diet of a young child. If unavoidably the child must be fed on sterilized milk or largely on some proprietary food the vitamins should be restored in the form of orange juice. An ordinary diet of fresh food provides all the vitamins necessary for normal needs. Should circumstances necessitate the use of dried rations, or a large proportion of canned foods, fresh fruit—such as oranges, lemons—and vegetables—such as potatoes, onions, cabbage, and squash, all of which can be stored—should be added to the diet.

SUMMARY

	Obtained from—	Uses.
Proteins or Nitrogenous Foods: *Chemical composition:* Hydrogen, oxygen, carbon, nitrogen; with various salts, sulphur, iron, phosphorus, etc.	*Animal:* Meat, fish, milk, cheese, eggs. *Vegetable:* Especially cereals and legumes.	Repair of tissues. Supply energy in the form of heat and muscular power.
Carbohydrates: *Chemical composition:* Oxygen and hydrogen (H_2O) and carbon.	*Starch:* Cereals, legumes, tubers, pith of plants (sago). *Glycogen* (animal starch), from oysters and other mollusks. *Sugars:* Sugar, fruit, honey, some vegetables (tomatoes, etc.), and milk (lactose).	Supply energy, especially muscular power; excess converted into fat and stored as such; also glycogen, stored in the liver. Can be used as sparers of protein or fats.
Fats and Oils: *Hydrocarbons:* Same as carbohydrates. Fatty acids (oleic, palmitic, and stearic) and glycerin.	*Animal:* Fat of meats, cream, butter, eggs (yolk). *Vegetable:* Oils, nuts, cocoa, and chocolate.	Same as carbohydrates, valuing bulk for bulk twice as much. Stored as fat in the tissues.
Minerals: Examples: Magnesia, soda, lime, sulphur, etc., in the form of soluble salts.	In all animal and vegetable foods: A sufficient quantity of all salts except sodium chlorid, or common salt, is supplied in an ordinary mixed diet. Common salt is added to all cooked foods.	Help in the building up and preserving of the tissues. Aid in digestion.
Organic Acids: Examples: Acetic, citric, tartaric, malic, oxalic, and lactic, in combination with potash.	Fresh green vegetables and fruit; milk that has not been subjected to high temperature; vinegar.	Necessary to nutrition.
Water: *Chemical composition:* Hydrogen and oxygen (H_2O).	Drinking-water, milk, soups, beverages; the juiçe of meats, fruits, and vegetables.	Regulates body-temperature. Dilutes all fluid tissues. Dilutes poisonous products of oxidation and other toxins. Aids in elimination. Is necessary to metabolism.

CALORIC VALUE OF FOOD

We see that not only are food-stuffs required for the repair of tissue, but that on them the body relies for the production of the *energy* necessary for its activities. By the *energy* of the body we understand its *heat* and its *muscular* or *motor power*.

Above, we said that the process by which the food-stuffs, prepared by digestion, were split up into their chemical elements and assimilated by the body-cells, were similar to the process by which fuel was consumed in burning. In the body this process is called *combustion* or *oxidation*. The relative value of fuels depends on the amount of heat engendered by their combustion and the length of time their heat can be sustained. A further value is reached when we use fuel not only to produce heat, but the heat to produce activity or power, as when heat is used as the motor power of machinery.

To understand what we mean by the caloric value of any food substance we shall regard it as the fuel used to provide the motor power of an engine. The energy of the body is expressed in every one of its activities; the action of the muscles in all the simple or complicated acts of movement, the action of the central nervous system in controlling all the activities of the body, of each separate organ in fulfiling its own functional activity, of each body-cell in assimilating from the food-stuffs just the element it requires for its repair and development, and, lastly, the activity of that force we know as the mind or intellect, which works through the medium of the body. Just as the different fuels have different values as heat and power producers, so, too, the different foods vary on this point. Some foods represent slow combustion, giving out a steady supply of heat and energy over lengthened periods; such foods we value for their *sustaining* qualities; other foods are more rapidly oxidized, and resemble a fuel that flares up quickly, giving out a high degree of heat, and as quickly dying down again; the effect of such foods is to stimulate the body for a short time. The proteins are more slowly oxidized than the starches, and again starch is more slowly oxidized than sugar, unless it has been par-

tially dextrinized by cooking. Sugar is the most rapidly oxidized of food-stuffs, and the heat and energy produced by its combustion are, in comparison, transitory. Alcohol produced by the fermentation of sugar is more rapidly and more completely oxidized than any other form of food; it is, therefore, of great value where immediate stimulation is necessary. Fat is a " concentrated fuel food," and, as has been said above, appears to be particularly necessary for the growth and development of young tissues.

Where we have combustion we have also a certain amount of waste, shown in the residue or *ash* remaining after the complete combustion of any fuel. In the same way the oxidation of food-substances produces certain waste-products in the body. The ash, or residue, of protein foods is known as *urea;* it is excreted by the kidneys and eliminated from the body in the *urine.* To a much less extent it is also excreted by the skin in the sweat. Where the kidneys fail in this function, the body becomes rapidly poisoned by the accumulation of urea in the tissues. A chronic, imperfect elimination of urea causes such conditions as gout, certain forms of rheumatism, etc. The acute condition, where no urea, or a very small amount, is eliminated is known as *uremia,* and is rapidly fatal if unrelieved.

The waste-products of carbohydrate combustion form carbon monoxid. If allowed to accumulate in the tissues, this poisons the body more rapidly than urea, less than five minutes producing death. On contact with the oxygen in the lungs carbon monoxid leaves the body in the form of carbon dioxid, or carbonic acid gas. The structural changes which take place in the body-cells as the result of combustion are spoken of as *metabolism.*

Of late years the question of the economic value of the different food elements as producers of heat and energy has received a great deal of attention. It has been made practical by means of an instrument known as the *bomb calorimeter,* to estimate the amount of heat and power produced by the various food-stuffs assimilated by the body. The amount of heat and power produced by the complete combustion of any one food-stuff is spoken of as

its *potential energy.* In the scale used for the comparison of the potential energy of different foods the unit or base of measurement has been named a *calorie,* or *heat unit.* One calorie represents the amount of heat necessary to raise the temperature of one kilogram of water one degree centigrade; this amount of heat represents in motor force sufficient power to lift one ton 1.54 feet. In comparing the *potential energy* of different foods, we speak of them as valuing so many *calories.* The proteins and carbohydrates have, weight for weight, the same caloric value, the fats rather more than twice as much. Water and organic salts, neither of which undergo combustion, have no caloric value.

Professor Atwater estimates the caloric value of foodstuffs as follows:

1 gm. protein (15½ grains)	=	4.0	calories.
1 gm. carbohydrate	=	4.0	"
1 gm. fat	=	8.9	"

Rubner's scale is slightly higher:

1 gm. protein	=	4.1	calories.
1 gm. carbohydrate	=	4.1	"
1 gm. fat	=	9.3	"

Both scales are in use.

The caloric value of food will, therefore, depend, not on the bulk, but on the proportion in which the above chemical elements are present. For example, the white of one egg, which weighs about one ounce, is composed almost entirely of albumin and water, the latter in the proportion of 86.2 per cent.; its caloric value is 14; the yolk, which weighs about half an ounce, contains less water, more protein, and about 33 per cent. fat, and represents a caloric value of 58. A tablespoonful of olive oil, which is almost entirely hydrocarbon, furnishes 135 calories.

Calories in Diet.—The caloric value of food is an important factor in preparing dietaries, either for the individual patient or for large numbers. It is estimated that a healthy man of average weight, between 130 and 150 pounds or 65 to 75 kilograms (1 kilo = 2.2 pounds),

requires for his daily consumption a diet that will furnish about 3000 calories, generally divided as follows:

125 gm. protein	furnishing	500	calories.
500 gm. carbohydrate	"	2000	"
50 gm. fat	"	445	"
		2945	"

Obviously, the amount of food will be influenced by many conditions, such as the size and weight of the individual, his state of health, etc., his age, and occupation. Less food is required if the life is sedentary, more if there is great muscular activity. A woman is considered to require about four-fifths the quantity of food required by a man, and children less in proportion to their age, *i. e.*, between the ages of six and nine about half as much, and so forth. In old age combustion takes place slowly, the body is less active, and, therefore, less food is required.

As a rule, in health the appetite is the best indication of the amount of food required. It is, however, important to see that, in the bulk desired, the proteins, carbohydrates, and fats are in the required proportion.

An ordinary meal of meat, vegetables, bread, and dessert represents the right proportions very fairly.

Where dietaries have to be made out for large numbers, the caloric values of the foods used should be given full consideration, in order to provide meals of good nutritive value, or, in other words, to get the largest results with a minimum of outlay. Those that have the arranging and ordering of such diets will find a good dietary computer, of which there are several on the market, an immense help. One should be chosen in which the chemical composition of the foods and their caloric value are clearly stated.

In dieting the sick at the present day the caloric value of the foods is given as much consideration as their digestibility. In acute illnesses accompanied by much tissue waste and active heat-production, as in many fevers, an increased number of calories may be necessary, and, if dieting is intelligently understood, may be administered without increasing the bulk of the food to be taken. Such a diet is spoken of as a *high caloric diet*. In other

conditions, such as gout, arteriosclerosis, etc., it may be necessary to reduce the calories while giving the ordinary amount of food-stuffs, and a *low caloric diet* is selected. In these circumstances the patient is usually weighed daily, and a certain number of calories given for each kilogram of the patient's weight. The food must be weighed and measured with strict accuracy. The metric system is gaining so much in favor that it is as well to accustom the pupils to its use in weighing and measuring.

In hospitals where the most modern methods obtain it is now the custom to order the individual patient's diet in the form of a prescription calling for so many calories of carbohydrate, protein, or fat; the prescriptions are worked out in the diet kitchen, attention being given to order the required amount of food with variety from day to day, and due consideration for individual preference. Some contrivance of box or small covered tray carries each diet from the diet kitchen directly to the patient. The patient benefits by having the diet most suited to his individual needs and tastes, and for the pupil nurses nothing can be better training. Not only must they realize the importance of food in the human economy, whether in health or in sickness, but they learn from practical experience the relative values of the different food-stuffs, and how and in what variety of ways to combine them so as to produce appetizing meals with the necessary chemical elements in proper proportion.

A diet kitchen, where such methods are carried out and proper instruction given, will obviously be in charge of a trained dietitian, an expense that many of the smaller hospitals feel a serious addition to their salary budget. At the same time, in treating disease, no one item is at the present day receiving more attention than dieting, and a nurse is certainly handicapped if she is not familiar with the routine work of computing diets in what is obviously a more scientific and intelligent manner than merely ordering a diet from a given list of permitted food-stuffs. Such instruction can hardly be left out of a nurse's education, so surely will she in private work meet with doctors who expect such knowledge from her. Tables giving the caloric

value of food-stuffs are available and there is no real difficulty in teaching each class of nurses their use, the instruction being given in connection with their practical work in the diet kitchen. A bulletin, giving the chemical composition and caloric value of every substance in use in America, is issued by the United States Department of Agriculture, and may be had by sending ten cents in coin to Superintendent of Documents, Washington, D. C. (Bulletin 28, Chemical Composition of American Food Materials).

From this, or any other comprehensive computation table, charts of the food substances in use in the hospital dietaries may be made out, giving the quantity of each required to yield 100 calories. This will be found more readily retained by the memory than tables of more varying numbers. The pupils will become familiar with the amount both by weight and by appearance required to give the necessary calories of the various chemical elements, and find that such a method of computing dietaries presents no real obstacle. Pupils may be given as an exercise to find the caloric value of a meal or of the whole diet of a day, and to remove the process by ordering a meal or meal to contain a given number of the required calories. In the modern treatment of certain diseases, such as diabetes, familiarity with such methods is essential, and is taught not only to nurses but to the patients themselves. (See Diabetes.)

Books that will be of value in starting such classes for nurses are Food Values, by Edwin A. Locke; Laboratory Handbook for Dietetics, by Mary Schwartz Rose; Elements of the Science of Nutrition, by Graham Lusk.

The tendency in many institutions, and in families where expense is a serious consideration, is to use an excess of the cheaper carbohydrate foods in the place of the proteins and fats. On account of their bulk, these foods satisfy the appetite. For economic considerations experiments have been made on a large scale to determine the value or disadvantages of a purely vegetable diet. The outcome of such experiments goes to prove the value of a mixed diet. A purely vegetable diet gradually produces a con-

dition of mental and physical inertia, and a lessening of the powers of resistance, and is, therefore, inappropriate where either physical or mental work is to be done. The protein contained in vegetable foods is present in much smaller proportion than in animal food, and is of a variety less soluble and more difficult of digestion. To obtain a sufficient supply of protein for the needs of the body, where active work is required, from vegetable foods, either alone or supplemented by milk and eggs, the bulk of food required would quickly cause disorders of the digestion.

Other experiments have been carried out, eliminating the carbohydrates from the diet. The results show a decrease in muscular power, since muscular energy is obtained from these foods; the physical endurance is, however, found to be greater on a protein diet than on a vegetable one.

An excess of protein in the diet leads to the formation of a larger proportion of urea. Where elimination is not active, this creates a tendency to those disorders associated with uric acid, such as gout and rheumatism. In mature life, where the body is less active and less repair of the tissues is required, and in people of sedentary habits, the proportion of protein in the diet should be diminished.

DIGESTIBILITY OF FOOD

A further highly important consideration in estimating the comparative value of different food substances in a diet is the *digestibility* of the various foods, since, to quote an old saying, " we live not on what we eat, but on what we digest."

Process of Digestion.—The work of splitting up foodstuffs into their chemical elements and changing them into *soluble* forms, so that they may be *absorbed* by the lymphatics and the blood, and finally *assimilated* by the individual body cell, is accomplished by the process we know as digestion, which takes place in the *mouth*, the *stomach*, and the *small intestine*.

As a first step, solid foods must be dissolved. This

process is already accomplished in liquid foods, for which reason liquid foods are a valuable form of diet in conditions of enfeebled digestion.

In order to be used by the body, food must further undergo the following changes:

1. *Proteins* (nitrogenous foods) must be converted into *soluble peptones.*

2. *Carbohydrates* must be converted into *dextrose.*

3. *Fats* must be either *emulsified* or *split up* into *fatty acids* and *glycerin.* They are not *digested* in the sense of either proteins or carbohydrates.

The above changes are brought about by the action of the *digestive juices,* of which there are three, each containing one or more active agents, known as *enzymes* or *ferments.*

The digestive juice in the mouth is the saliva, and contains the ferment *ptyalin.* The function of ptyalin is to begin the digestion of the carbohydrates. The starches, except such as have already been *dextrinized* (see below), are converted into *maltose* before their final change into *dextrose.*

Substances soluble in water, such as salt and sugar, are dissolved in the mouth. The saliva has no effect on proteins or fats. Food stays such a short time in the mouth that the action of the saliva is restricted.

The digestive juice in the stomach is the *gastric juice.* It contains hydrochloric acid (about 0.2 per cent.) and two ferments, pepsin and rennin.

The hydrochloric acid provides the acid medium necessary for the gastric ferments to act, and prepares the protein for the action of the ferments; pepsin converts protein of every variety into soluble peptones; rennin coagulates the casein in milk, converting it into solid curds, which are then digested in the same manner as other protein foods. During the digestion of milk a ferment (lactic acid) is also elaborated from the milk itself, which aids in the process of digestion. Fats are melted and set free, but not otherwise acted upon. The carbohydrates remain unchanged. Food leaves the stomach in the form of a thick, milky fluid known as *chyme.*

In the small intestine food is acted upon by the *pancreatic juice*, the *bile*, and the *intestinal juice*. By far the greatest part of all digestion is carried out in the small intestine.

The *pancreatic juice* excreted by the pancreas contains three ferments—*amylopsin*, *trypsin*, and *steapsin*.

Amylopsin completes the conversion of the starches into maltose.

Trypsin completes the digestion of the proteins.

Steapsin splits up fats into fatty acids and glycerin, and emulsifies fats.

The *bile* excreted by the liver contains certain salts which also act on the fats, emulsifying them and splitting them up into fatty acids and glycerin, in which forms they can be absorbed. The bile is also considered to act as an intestinal disinfectant, preserving the contents of the intestines from putrefaction, and has further the property of preparing the walls of the intestines for the absorption of the emulsified fat.

The *intestinal juice*, or *succus entericus*, excreted in the walls of the small intestine, acts as a diluent to the intestinal contents, and contains a ferment (*invertin*), which it is considered causes the change of the *maltoses* (prepared from starch by the *ptyalin* and the *amylopsin*) and the *sucroses* into *dextrose*, in which form only it can be taken up by the blood. The change, it is supposed, takes place during absorption through the intestinal walls.

Each of the above ferments acts only in that part of the digestive tract in which it is produced. Ptyalin can act only in an alkaline medium, such as the saliva, its action is, therefore, checked by the acidity of the gastric juice; pepsin and rennin are only active in an acid medium, such as the gastric juice; their action is, therefore, checked by the alkalinity of the digestive juices in the intestines.

The ferments further require that the medium should be at blood-heat; iced drinks, therefore, and ice-cream, etc., by temporarily lowering the temperature of the gastric juice, delay digestion somewhat.

The large intestine secretes no digestive juices, but offers a large surface from which water and food-stuffs in the

soluble forms in which they can be used by the body may readily be absorbed. As the digestive juices continue their action on the intestinal contents in the large intestine, digestion may, to this extent, be said to take place in the large intestine. There are no digestive juices in the large intestine, however, to digest food-stuffs introduced into the alimentary tract by the rectum. The work of preparing the food-stuffs must, therefore, in rectal feeding, be performed outside the body; the process is known as predigestion or peptonizing.

The undigested and indigestible portion of the food-stuffs are passed out of the body as the *feces*.

Mechanical Aids.—Digestion is also aided by certain mechanical processes. In the mouth food is masticated, that is to say, crushed and chewed and thoroughly mixed with the saliva. It is then passed into the stomach by the action of swallowing.

In the stomach food is churned by the mechanical action of the stomach-walls, and passed forward, a small quantity at a time, to the intestines by a wave-like, muscular movement of the stomach-walls, known as *peristalsis*.

The peristaltic action is continued in the intestine, and the food thereby forced gradually forward in the direction of the anus. The presence of bile is considered to help in this peristaltic movement; if the liver is sluggish and little bile poured out, the peristaltic action is likely to be weak. This is one of the commonest causes of constipation.

Stimulation of Juices.—The digestive juices are stimulated by the presence of food. Recent research has also shown that both the quantity and the quality of the juices are affected by the different kinds of food-stuffs and by the individual liking for the food taken. Thus, food eaten with an appetite is considered to be more easily digested than the same food taken unwillingly or with indifference. This is an important point for nurses to remember, since the appetite may be tempted by dainty service, quiet and pleasant surroundings, and by offering just the right quantity at the right time. Slovenly service, disorderly surroundings, unpunctuality, or an overheaped plate may

affect even a healthy appetite. Where possible, the individual taste should be consulted, and, even where the diet is restricted, pains should be taken to vary it as much as possible.

The fact that the quantity and quality of the digestive juices varies with the different varieties of food-stuffs demonstrates further the value of a well-balanced, mixed diet. The supply of all secretion depends largely on the demand, and the same holds true of the secretion of the digestive juices. If, for example, there is but little demand for protein digestion, less gastric juice is secreted, and the proportion of the composition is somewhat altered. This should be remembered in adding to a patient's diet any food-stuffs that have been withheld, as, for instance, in reintroducing protein foods after a patient has been kept for a time exclusively on carbohydrate foods; the change should always be effected gradually.

The *sight* and *smell* of food, when pleasant to the appetite, stimulate the flow of the saliva, and probably of the other digestive juices. That this fact is widely accepted we know from the homely saying that good food makes the mouth water.

The temperature of the food affects the secretion of the gastric juice. The presence of food in the stomach causes the dilatation of the blood-vessels in the walls of the stomach, and a large increase in the quantity of blood. It is estimated that nine times the ordinary amount of blood is present in the walls of the stomach during digestion. Hot fluids help in the dilatation of the vessels, and so stimulate digestion; ice-cold drinks and foods, by contracting the more superficial vessels, are considered to delay digestion somewhat, as well as by arresting the activity of the ferments, as noticed above. On the other hand, cold is held to stimulate the peristaltic action of the stomach.

ABSORPTION OF FOOD

The absorptive powers of the different parts of the digestive tract vary considerably. A very small amount of converted carbohydrates, alcohol, and common salt may be absorbed in the mouth; in the stomach the same, to-

gether with a small proportion of peptones and mineral salts, are absorbed without undergoing intestinal digestion. In the small intestines foods of every sort are absorbed, especially the emulsified and saponified fats, which are taken up by the lymphatics in the walls of the small intestine (the *lacteals*); lastly, the large intestine acts as a reservoir from which the remainder of the food-stuffs and water is absorbed.

With the exception of the fats taken up by the intestinal lymphatics, the food-stuffs are collected from the superficial blood-vessels of the alimentary tract by the *portal vein*, and carried directly to the liver; thence to the vena cava, and so finally distributed through the whole arterial system. The liver, besides taking from the blood what is necessary for the use of the individual cells of the liver itself, also stores up a certain amount of the digested carbohydrates, which it converts into glycogen, or animal starch. As glycogen is insoluble, it is converted back into *dextrose*, when it is given back to the blood.

The fats absorbed by the lacteals also finally reach the general circulation through the thoracic duct, a lymphatic vessel which collects the contents of the intestinal lymphatics and passes them into the general circulation at the junction of the left subclavian and left internal jugular veins.

The **comparative digestibility** of the various food-stuffs is, for convenience, reckoned by the length of time that the foods take completely to leave the stomach. A full meal of mixed ingredients takes about four hours to leave the stomach. A light meal of, for example, tea or coffee, bread, and eggs, should have left the stomach in from one and a half to two hours. Tables may be found in most books on dietetics giving the comparative digestibility of the common varieties of foods.

Conditions Disturbing Digestion.—Many conditions disturb the digestion to a greater or less extent. A meal should not be taken immediately after prolonged physical exertion, nor should exercise be taken immediately after a meal. On the other hand, exercise an hour or two after a meal promotes absorption. Very violent exercise im-

mediately after a meal arrests digestion altogether, causing severe headache, vomiting, and sometimes cardiac failure. Nervous irritation, excitement, or strong emotion will materially upset the digestion, while congenial company and pleasant surroundings actually promote digestion. Bathing disturbs digestion by diverting the necessary blood-supply from the stomach, and should not be practised after a meal. Digestion during sleep is continued slowly; the last meal of the day should, therefore, be given time to digest before bedtime. The stomach should be allowed to rest for a time before each meal; for this reason the habit of eating between meals is pernicious.

SUMMARY OF THE DIGESTIVE PROCESSES

Mouth	Saliva: Alkaline.	Ptyalin:	Converts starches into maltose (sugar and salt, etc., are dissolved).
Stomach.....	Gastric juice: Acid.	Pepsin:	Converts proteins into soluble peptones.
		Rennin:	Coagulates casein, forming curds.
		(Fats are set free and melted.)	
Intestines....	Pancreatic juice: Alkaline.	Amylopsin:	Completes digestion of starches; dissolves cellulose.
		Trypsin:	Completes digestion of proteins.
		Steapsin:	Splits fats into fatty acids and glycerin. Emulsifies fats.
	Intestinal juice: Alkaline.	Invertase:	Changes sucroses into dextrose.
	Bile: Alkaline.	Bile salts:	Emulsify fats. Prepare the walls of the intestines for absorption of fats. Avert putrefaction.

CHAPTER XXII

THE PREPARATION OF FOOD

Effect of Cooking on Proteins—Carbohydrates—Fats—Milk—Cream—Skimmed Milk—Whey—Curds—Dilution—Fermentation—Heating—Predigestion—Flavoring—Milk as Infants' Food—Modification—Signs of Indigestion of Milk—Eggs—Gruels—Meat Broths and Extracts—Water—Beverages.

THE process of digestion is materially helped by the manner in which raw food-stuffs are prepared and cooked.

To take the most obvious example, we do not use the cereals as food in the form of oats and wheat, as we find them growing. The grain is first removed from the husk, then ground and rolled, thus producing flour and meals, which are easy to cook, and when cooked, are readily acted upon by the digestive ferments, and contain comparatively little material that cannot be used by the body.

The objects of the processes we know as *cooking* are, by the exposure of food-stuffs to certain temperatures, by the chemical action of various alkalis and acids, and by combination with other food-stuffs, extractives, or condiments, to render food more palatable and more easily digested and absorbed by the body.

Exposure of raw food-stuffs to heat is the simplest form of cooking; heat, combined with moisture, has the general effect of softening hard or tough tissues, such as meat fiber and the indigestible cellulose of plants, and making them more readily broken up and dissolved by the digestive processes. On the different varieties of food-stuffs heat and moisture produce important chemical changes, on the understanding of which the whole principles of cooking are based.

PROTEINS

The **albuminoids** are dissolved in cold water and coagulated by heat or acids. For example: If the white of an egg (egg-albumen) is stirred in cold water, it is dissolved; if it is dropped into hot water, it becomes coagulated and solid; casein, the principal albumin of milk, is changed into a solid curd on the addition of an acid, such as rennet.

The **albumins of meat** are affected in the same way. If raw meat is placed in cold water, the albumins are dissolved and the juices drawn out into the water; if plunged into hot water, the albumins are coagulated and seal up the blood-vessels, thus, keeping the juices in the meat. Thus, if, we want nourishing broths or stews we put the meat in cold water and heat it slowly; if the meat itself is to be the nourishing part, we expose it at once to a high temperature, as in roasting, broiling, or baking. The fibrin of meat is not soluble either in cold or hot water. We, therefore, eliminate fibrin entirely where the digestion is weak, or divide it up very finely, as in minces.

The **gelatinoids** are drawn from bone, skin, and tendon by prolonged boiling, and are not soluble in cold water. Although not valuable as food in the same sense as albumins, soups made from bone-stock in this way are rich in minerals, especially phosphate of lime, which is found principally in bone.

Raw meat is insipid and flavorless. Exposure to heat brings out the distinctive flavor of meats, as does also the addition of common salt. It is for this reason that the beef-juice of slightly cooked meat is more palatable than that expressed from raw beef, and still more so if salt is added.

CARBOHYDRATES

The **starch** in vegetable foods is inclosed in a capsule of *cellulose*, which must be broken down before the starch can be acted upon by the digestive ferments. Exposure to heat causes the starch-grains to swell, so that the cellulose is burst and the grains of starch set free, to be acted upon by the digestive ferments. Soaking in cold water will separate the starch grains and thus prevent lumping while they are cooking.

Fig. 217.—A class in dietetics, Presbyterian Hospital, New York (Aikens' "Hospital Management").

We saw above that starch must be converted into *dextrose* before it is used by the body. This process can be partially accomplished in cooking, either by prolonged exposure to heat, or by the addition of certain ferments, such as diastase of malt, which have the property of dextrinizing starch. Farinaceous foods, Mellin's food, and other proprietary foods owe their value to this process.

Cane-sugar (*sucrose*) is changed to grape-sugar (*dextrose*, one of the *glucoses*) by prolonged exposure to heat. As grape-sugar is only half as sweet as cane-sugar, much of the sweet taste is thus lost. For this reason sweetening is usually added to dishes toward the end of cooking.

Cereals are cooked in a large proportion of boiling water, with the addition of salt, which brings out the flavor. Where the meal is fine or flour is used, the grains should always be separated by being mixed first in cold water to prevent lumping. Cereals should be cooked slowly and very thoroughly.

Vegetables.—"All plants used for food except grains and fruit" (Farmer). One of the chief objects in cooking vegetables is to break down and soften the *cellulose*, which is the structural base of all plants. Although cellulose is not used by the body, it is valuable as supplying bulk. Green vegetables are cooked in boiling water to which salt is added. Salt brings out flavors and coagulates the legumen in peas, beans, and lentils. Ground vegetables (potato, turnip, etc.), which require more time to soften than green vegetables, are best placed in cold water and gradually brought to boiling-point. Salt is added at the end of cooking, as it to some extent hardens the water and delays the process of softening.

FATS

Cooking has very little effect on the digestibility of fats and oils. Certain acids are set free which, when the fats meet with the digestive juices, produce a finer emulsion than is the case with uncooked fats. This is of importance where patients do not assimilate fats. In such cases, for example, boiled bacon may be substituted for butter, cream, etc.

In good cooking the valuable *mineral salts* are preserved;

in careless and unintelligent cooking they are frequently lost, and some of the nutritive value of the food is thus wasted.

On the above facts the principles which govern the cooking of foods, the temperature necessary, the time required, etc., are based. To carry these principles further and study their effects in the preparation of all the various food-stuffs we consume is beyond the scope of a general text-book, and belongs rather to a full course in cooking. Certain simple forms of food it is, however, from the beginning of her training, part of a nurse's duties to prepare and administer. It seems essential that she should understand the comparative importance of these foods, their value in the human economy, and the different forms of preparation by which they may be made appetizing and most readily digestible.

In the large majority of illnesses the digestive processes are deranged, and it becomes necessary to provide the body with food in those forms in which it can be most readily digested. It is essential that the diet should include all five food elements in a proper proportion. At the same time, as with rest in bed the body has no motor activity to perform, a much smaller quantity of food is required. To give an ordinary quantity of solid food to a patient confined to bed is likely to cause some of the disorders of deficient elimination. The simple forms of food to which we shall confine ourselves are milk, eggs, beverages, soups, and gruels, foods which constitute the entire diet of the majority of acute cases.

MILK

Of all the various food-stuffs, *milk* is the most valuable to man, and for the following reasons:

1. It contains all five food elements in their proper proportion; for this reason it is often called the *perfect food*.
2. It is generally procurable.
3. It is comparatively inexpensive.
4. Usually it is easily digested.

In many of the large agricultural districts of the world milk is the principal article of diet, and with cheese and

eggs the only animal food taken; it is also, as we know, the natural and sole food of infants and all young mammals, and an important article in the diet of children during the years of their most rapid development.

Milk as a sole article of diet is not suitable for people leading active lives; to obtain from milk alone the quantity of protein necessary for a man in active work as much as four quarts of milk would be required, at the same time he would be taking too much fat and too small an amount of carbohydrates. The consequence of such a diet would be an undue accumulation of adipose tissue and a decrease in muscular energy.

In the agricultural districts just mentioned the extra protein is taken chiefly in the form of cheese, and the carbohydrates as potatoes and bread. In the diet of the sick an increase of proteins, if desired, is usually given in the form of eggs, especially the easily digested whites of eggs, and meat broths, and the carbohydrates in the forms of gruels, barley water, or simple farinaceous foods.

The **chemical composition** of cows' milk is, on an average: Fat, 4 per cent.; carbohydrates, 4.5 per cent.; protein, 4 per cent.; mineral salts, 0.7 per cent.; and water, about 87 per cent. The *proportion* in which the fats, proteins, and carbohydrates are required in the diet of an adult doing active work are as fat, 2; protein, 4, and carbohydrates, 18. Oysters and similar shell-fish are the only other food-substances which contain the five elements in something the same proportion as milk. For this reason they are, when taken raw, on account of their easy digestion, a valuable food in the sick-room. They cannot, however, be taken in sufficient quantity to take the place of milk, even if their price did not make them a much more expensive food. The chemical composition of an oyster is, on an average: Fat, 1.1 per cent.; carbohydrates, in the form of animal starch or glycogen, 3.3 per cent.; protein, 6.1 per cent.; mineral salts, 0.9 per cent., and water, 88.3 per cent.

Indigestibility of Milk.—A very little experience is needed to show that milk, as obtained from the cow, cannot be digested by infants or by a large proportion of sick or convalescent persons. An exclusive diet of milk

is apt to produce gastric irritation, a coated tongue, nausea, constipation, and biliousness, or, less frequently, diarrhea; often the milk cannot be taken in sufficient quantities for purposes of nutrition. Many persons also who, when in health, drink milk freely, when ill dislike the taste.

At the same time there is no perfect substitute. An important part of our work is then to find out in what way the disadvantages of milk as a diet for the sick can be overcome.

The principal cause of the indigestibility of milk is the protein caseinogen, which, by action of the ferment *rennin,* is converted in the stomach into solid curds. Where the digestion is enfeebled, these curds are frequently found impossible of digestion.

The biliousness, which is an occasional symptom where the diet is exclusively of milk, is commonly caused by the large proportion of fat.

These disadvantages may be mitigated in several ways:

1. Milk may be *split up*, and the parts that disagree with digestion either altered or left out.

Cream.—If we take the cream alone, we obtain, in the same bulk, a higher proportion of fat (from 10 to 30 per cent., instead of 4 per cent.), while the proteins, carbohydrates, and salts remain about the same. Cream, therefore, is used with advantage where emaciation makes the use of an excess of fat necessary, 1 ounce of rich cream containing as much fat as 6 or 8 ounces of whole milk. Rich cream, being largely pure fat, has consequently a very high caloric valve. This makes it a valuable food where the greatest results are desired, with the least amount of work for the digestive organs.

Skimmed or Fat-free Milk.—Skimmed milk is milk with the fat removed, the protein, carbohydrates, and salts remaining. It is, therefore, well borne in many cases of *intestinal* indigestion, and in jaundice, where the bile is decreased or absent, in which condition the fats are not well borne (Chap. XXI).

Whey.—Whey is milk—as a rule, skimmed milk—from which the *casein* has been removed, usually by the action of rennet. It contains no fat or casein, 1 per cent. protein

in the form of lactalbumin, and the full proportion of carbohydrates and salts. The lactalbumin is the same as the albumin found in the blood, and, therefore, readily assimilated. Whey is often of great value where the digestion is seriously impaired, especially in the feeding of young, feeble infants.

The **curds** obtained by this process, which contain the casein, together with carbohydrates and salts, form an agreeable change in an exclusive milk diet, but are not suitable where the digestion of proteins is difficult.

Buttermilk.—Buttermilk is the sour, acid fluid separated from sour milk or cream by *churning*, by which process the fat is removed in the form of butter. In chemical composition buttermilk closely resembles skimmed milk, and is, for the same reasons, useful in cases of intestinal disorders. The sour taste is due to the bacterial activity that has caused the souring or ripening of the milk. It is often appreciated where sweet milk is disliked. Buttermilk has a decided laxative effect, and is, therefore, not suitable in conditions where diarrhea exists, and is, on the other hand, peculiarly serviceable in conditions accompanied by biliousness or obstinate constipation.

2. The **dilution of milk** with hot water or with one of the carbonated table waters (Apollinaris, Vichy, seltzer, etc.) is frequently the simplest means of increasing the digestibility of milk. The latter not only give to the milk a refreshing, agreeable taste, but have the effect of separating the particles of casein, which consequently solidifies in less dense curds.

Milk may also be diluted by being mixed with thin gruels, toast, bread-crumbs, or crackers. This increases the nutritive value of the diet, and has also the effect of causing the casein to form in lighter curds. Gruels should not be given where there is any tendency to diarrhea.

3. **Lessening Acidity.**—Substances may be *added* to the milk to increase its digestibility.

An alkali, such as *lime-water* or *bicarbonate of soda*, by lessening the acidity of the medium, restricts the curdling action of the rennin on the casein, and causes the curds to form in much smaller, lighter masses, resembling more the curds of natural human milk. Lime-water is usually

added in the proportion of 1 part lime-water to from 6 to 12 parts of milk; bicarbonate of soda, in the proportion of about 1 grain to the ounce. The latter is used largely in infant feeding.

The addition of *common salt* is frequently observed to aid in the digestibility of milk. We saw that the stomach uses common salt in the manufacture of the hydrochloric acid of the gastric juice: patients who are kept for long on an exclusively milk diet frequently suffer from lack of the salt.

4. **Fermentation.**—Fermentation is the disorganization and oxidation of the carbohydrates (Gould).

Among the primitive races of the East the process of fermentation has been known for ages as a means of preserving milk and increasing its digestibility. At the present day fermented milk is found invaluable in many severe gastric disorders, especially in chronic varieties, and rarely fails to be retained.

Koumiss, matzoon, and kefir (see Recipes) are the forms of fermented milk in use; they differ but slightly from each other in composition. In the East mares' or asses' milk were commonly used; in this country cows' milk is preferred, and is more readily attainable.

5. **Heating.**—Hot milk frequently appears more easily digested than cold, probably from the stimulating effect of hot fluids on the gastric secretions. Care must be taken not to bring the milk to a higher temperature than 155° F., or the albumins will be coagulated and rendered less easy of digestion. (See Pasteurization and Sterilization.)

6. **Predigestion.**—By the addition of a ferment resembling the pepsin of the gastric juice, proteins may be converted into soluble peptones. The process is frequently used for the predigestion of the protein in milk, in cases where the digestion is greatly impaired, and for rectal feeding. Several preparations for the predigestion or peptonizing of milk, etc., are on the market (see Recipes), all having for their object the conversion of proteins into soluble peptones.

If milk is completely peptonized, it has a peculiarly bitter taste; this is objectionable except occasionally, in special cases, such as acute catarrhal jaundice, where

the patient frequently craves bitter-tasting foods. The digestive process can be arrested at the desired point, either by placing the milk on ice or by bringing it quickly to the boiling-point. Like the ferments in the digestive juices, the artificial peptonizing agents can act only at certain temperatures, and in a medium of a certain degree of acidity or alkalinity. To obtain accuracy on these points the directions which accompany the various peptonizing preparations must be carried out exactly.

7. **Flavoring.**—Quite frequently the taste of milk is objected to; the difficulty may be overcome by flavoring the milk with weak freshly made tea or coffee, cocoa, chocolate, etc.; with the two latter the nutritive value of milk is increased.

Milk may also be given in solid form, as junket, blanc-mange, or as milk jelly (see Recipes). These forms are frequently prescribed in cases of paralysis of the soft palate (a common sequela of diphtheria), as solids are then more readily swallowed than fluids. Ice-cream is also valuable, flavored with simple essences or fresh fruit. It is too rich in fat, however, to be taken in large quantities. Where a milk diet is continued over long periods, as, for example, in cases of acute nephritis, much ingenuity is required to prevent the food becoming hopelessly monotonous. It may be altered in any of the ways just suggested, and the form varied at the different hours of nourishment.

Example of a milk diet for the day:

7 A. M.	Cup of milk flavored with hot weak tea or coffee.
10 A. M.	Glass of milk with Vichy, etc.
1 P. M.	Dish of curds and whey with cream. Varied with blanc-mange or ice-cream.
4 P. M.	Cup of milk flavored with cocoa.
7 P. M.	Glass of warm milk or milk and hot water.

Frequently a light carbohydrate diet is combined with the milk diet, and milk-toast, gruels, and farinaceous puddings may be used to give variety, and light cakes, such as lady-fingers or simple crackers, added as dainties. Another method of flavoring milk or cream is to serve it as a soup, flavored with a small amount of some well-cooked vegetable, choosing those which are least rich in

proteins, such as tomatoes, asparagus, spinach, or onions, and season with butter and salt. Pepper must be avoided where the kidneys are irritated or the digestive organs impaired.

Where milk is given as an additional nourishment with a mixed diet, it should not be taken with a heavy protein meal, since the casein in itself taxes the digestion considerably. It is best taken with a cereal or a farinaceous pudding, or by itself with a cracker, as a light luncheon between meals.

Milk-punches or white wine whey are also favorable ways of taking milk where alcohol is added to the diet. (See Recipe.)

MILK AS A FOOD FOR INFANTS

To use cows' milk as a food for infants it is necessary to alter or modify it so as to bring its chemical composition to resemble more closely that of human milk, the natural food of infants.

Human milk contains a smaller proportion of fats, proteins, and mineral salts than cows' milk, and a larger proportion of sugar. The proportion of water is about the same in either.

	Cows' Milk.	Human Milk.
Fats	4.0 per cent.	3 to 4 per cent.
Sugar (lactose)	4.5 "	6 to 7 "
Protein	4.0 "	1 to 2 "
Salts	0.7 "	0.2 "
Water	about 87.0 "	about 87.0 "

The **protein of milk** is composed of casein and lactalbumin. Casein, as we have seen above, is difficult of digestion, while lactalbumin is soluble and readily absorbed.

In cows' milk the proportion of casein is greatly in excess of the lactalbumin; in human milk there are nearly three parts of lactalbumin to one of casein; the protein of human milk is, therefore, more easily digested than that of cows' milk. The curds formed during the digestion of cows' milk are hard and dense; those of human milk are lighter, soft, and flocculent. Cows' milk has a slightly acid reaction; that of human milk is slightly alkaline. Human milk, as the infant receives it, is free from any external

contamination, either from bacteria or dirt, and is at the natural temperature of the body; cows' milk, on the other hand, must necessarily be handled, can only by the most scrupulous care be kept from contamination, and is subject to several changes of temperature before it is given to the infant.

Another important point is that human milk, to some extent, changes with the development of the child, in order to meet the demands of its growth.

From the above it will be seen that cows' milk cannot be a perfect substitute for human milk. Very frequently, however, it is the best food available. In these circumstances we do our best to imitate as closely as possible the human milk as the infants receive it. The process of alteration is known as *modification.*

To **modify cows' milk** we first ascertain the total quantity in ounces required for a given number of feedings. We then take as a basis cream of a known percentage, say, for example, 16 per cent.; this will supply us with fats in the proportion of 16 per cent. to 4 per cent. protein and 4.5 per cent. of sugar.

If we dilute the fats with water down to the required proportion (3 to 4 per cent.), we shall also reduce the proteins and the sugar, and we already have too small a percentage of sugar to start with. We must, therefore, increase these ingredients.

To *increase the protein* of the mixture, we add skimmed milk, which is free of fat, but contains 4 per cent. protein and 4.5 per cent. sugar; the *sugar* we increase by simply adding a sufficient quantity of dry sugar of milk.

Finally, when we have, by mixing cream, skimmed milk, and sugar, obtained the full amount of fat, sugar, and protein required in the total feedings, we take a sufficient quantity of water to make up the necessary bulk, and divide the whole amount equally into the number of feedings required.

To make the above calculation is obviously a somewhat complicated arithmetic problem. Several formulas, however, have been devised to simplify the process, by means of any one of which the required foods may be quickly prepared.

One in common use in hospital work is by Dr. Baner. It will be found simple to use, and is sufficiently accurate for practical purposes.

Dr. Baner's Formula for the Modification of Milk.

Given: The quantity desired in ounces.
The desired percentage of fat.
The desired percentage of sugar.
The desired percentage of protein.

To find in ounces cream, milk, water, and sugar of milk:

$$\text{Cream} = \frac{\text{Quantity} \times (\text{Fats} - \text{Proteins})}{\text{Percentage of cream} - 4.}$$

$$\text{Milk} = \left(\frac{\text{Quantity} \times \text{Proteins}}{4}\right) - \text{Cream.}$$

$$\text{Water} = \text{Quantity} - (\text{Cream} + \text{Milk}).$$

$$\text{Sugar} = \frac{(\text{Sugar} - \text{Protein}) \times \text{Quantity}}{100}.$$

To work out an example, let us take a formula requiring a percentage of fats 3, sugar 6, proteins 1—about the average composition of human milk. We will use a cream with a fat percentage of 16, and estimate the quantity required at 20 ounces.

To find the cream required:

Q. $20 \times (\text{F. } 3 - \text{P. } 1) = 40 \div (\text{percentage of cream } 16 - 4) = 3\frac{1}{3}$ (cream in ounces).

To find the milk required:

Q. $20 \times \text{P. } 1 = 20 \div 4 = 5 - \text{Cream } 3.33 = 1\frac{2}{3}$ (milk in ounces)

To find the water required:

Q. $20 - (\text{Cream } 3\frac{1}{3} + \text{Milk } 1\frac{2}{3}) = 15$ (water in ounces).

To find the sugar required:

$(\text{S. } 6 - \text{P. } 1) \times \text{Q. } 20 = 100 \div 100 = 1$ (sugar in ounces).

Thus, to modify ordinary cows' milk so as to obtain 20 ounces, in which the percentage of fats, sugar, and proteins shall be 3, 6, 1, we require:

Cream (16 per cent.)	$3\frac{1}{3}$ ounces.
Milk (skimmed)	$1\frac{2}{3}$ "
Water	15 "
	20 ounces.

Sugar of milk 1 ounce (dissolved in the whole quantity).

In hospital work the percentage of fat in the cream is readily ascertained in the laboratory. Where this is not practical, it is usual to use the tops of milk bottles, calculating the fat in the following manner:

Upper 10 ounces, 10 per cent.
" 8 ounces, 12 per cent.
" 6 ounces, 20 per cent.

Cream that is left to rise and not separated artificially is known as gravity cream.

It is usually easier to teach the pupils to carry out the calculation in decimal fractions rather than in vulgar fractions. In estimating the quantity in ounces (where the metric system is not used throughout) the ounce may, to facilitate calculation, be taken as 500 (480 minims), which makes each $\frac{1}{10}$ part to represent 50 minims instead of the 8 parts of 60 minims each.

To the prepared mixture an alkaline is frequently added to aid in the digestion of the protein, since in modifying we do not change the proportion of casein and lactalbumin in the protein, and the casein is still in excess. To help in the digestion of the casein bicarbonate of soda ($\frac{1}{2}$ grain to each ounce) is frequently used, or lime-water, from $\frac{1}{10}$ to $\frac{1}{6}$ part. If lime-water is used, a correspondingly smaller proportion of plain water will be required. The formula to find the water will then read:

$$\text{Water} = \text{Quantity} - (\text{Cream} + \text{Milk} + \text{Lime-water}).$$

Milk is one of the best media for the cultivation of germs, and it becomes a question in what way we can best reproduce the *sterile* quality of human milk.

Sterilization.—At one time it was considered best to

sterilize the cows' milk by subjecting the prepared food to a temperature of 212° F. for thirty minutes. By this process, however, much of the nutritive value of the milk is lost in the skin which collects on boiled milk and is very difficult to reincorporate.

Fat, coagulated albumin, and some of the salts of milk, all parts of high nutritive value, are contained in the skin. Milk also appears less easily digested after it has been boiled. A continued diet of boiled milk quite commonly causes constipation from insufficiency of fat. It is considered that the exclusive use of sterilized milk may also be a cause of infantile scurvy, probably from the loss of vitamin destroyed by the high temperature. Where sterilized milk is considered necessary, many doctors add to the diet the white of an egg ($\frac{1}{2}$ to 1 in the day) and a small quantity of orange-juice daily. They are given in water (separately) between the milk feedings. Orange-juice is not usually ordered until after the sixth month.

At the present time **pasteurization** is preferred to complete sterilization. In pasteurizing milk the prepared food is subjected to a temperature of from 155° to 167° F. for thirty minutes. (See Recipe.) At this temperature pathogenic bacteria (disease-producing micro-organisms) and also the non-pathogenic micro-organisms that cause the souring of milk are destroyed. Spores (p. 359) are, however, not destroyed by this process, and if allowed time and exposed to a suitable temperature, may develop. Pasteurization is not considered to affect materially the nutritive value of milk, and is, for practical purposes, accepted today as the best method of insuring uncontaminated milk. Some authorities, however, consider that the vitamins in milk are destroyed by pasteurization.

Keeping Milk Pure.—Where the milk can be brought straight from the cow to the consumer, under strictly hygienic conditions, kept during the transit at a temperature not above 45° F., and used before it is many hours old, most doctors consider the milk is best digested and most nutritious if neither pasteurized nor sterilized.

It then becomes doubly necessary to preserve the milk from contamination or from changes due to temperature while storing and preparing the mixture. The whole

process is carried out under strict aseptic precautions. The bottles, spoons, etc., used are sterilized previously by boiling, and laid out conveniently on a clean sterile towel. Rinsing during the process must be done with sterile water, wiping with a sterile towel. The nurse's hands should be scrubbed as for an operation, and kept clean throughout. As a further precaution, a sterile gown is generally worn over the uniform during the process.

The simple implements required are the feeding-bottles, a graduated glass for measuring, a funnel, a spoon, a pitcher (containing sterile water), and sterile non-absorbent cotton. The milk and cream are taken direct from the bottle in which they are delivered. The bottles should be kept in the ice-box until required, and the mixtures replaced in the ice-box as soon as they are prepared. The feeding-bottles each contain one entire feeding only, a sufficient number for the day's feeding being prepared at a time; they are corked with sterile cotton and clearly marked with the baby's name or number. At the hour of feeding the bottle is placed in a bowl of hot water until it is the required temperature, and a clean nipple substituted for the cotton. The bottles used should have the nipple directly attached to the bottle. Rubber tubing is impossible to keep clean, and should never be allowed.

As soon as the bottle is finished, it should be rinsed in cold water, washed in hot suds, rinsed, and set aside clean, to be sterilized with all the other bottles before being used again. This may be done by boiling for half an hour, or by placing for fifteen minutes in the autoclave.

The nipples should be rinsed inside and out under running cold water, then washed in hot suds, rinsed, and boiled for five minutes, after which they may be put away dry in a clean sterile towel or placed in a jar of boric-acid solution until required. Every baby should keep its own nipple. To keep the nipples from floating on the top of the antiseptic solution, they may be loosely tied in small squares of gauze, to a bunch of which, for weight, a pair of forceps is clipped, otherwise they will only float.

Whey, buttermilk, barley-water, and thin gruels may also have their place in the baby's dietary and take the

place of water in diluting the food. (See Recipe.) When barley-water or gruel is used, less sugar will be necessary, since they are already rich in carbohydrates. Starchy foods are not usually ordered before the eighth month.

In giving any form of starch to a baby, it is necessary to remember that, at first, there is no ptyalin in the saliva, and that, even after the saliva flows freely, the percentage of ptyalin is small. Starches must, therefore, be dextrinized, either by prolonged exposure to heat or by the addition of a dextrinizing agent. (See Recipe.) After the tenth month beef-juice is sometimes used for feeble infants.

The **capacity of a baby's stomach** is small, and the amount of food given at a time must be regulated accordingly. As the child grows, the capacity of the stomach increases and the food may be given in increased quantities at longer intervals.

Capacity of the Stomach

At birth	1 ounce.
At 4 weeks	2½ ounces.
At 8 "	3½ "
At 3 months	4 "
At 5 "	5½ "
At 9 "	7½ "
At 1 year	9 "

The **feedings** are usually ordered in the following quantities, gradually increased. It must be remembered that the weighing scales are a more accurate guide to the baby's requirements than its age.

	Day (6–10)	*Night* (10–6)
First week (after first two days)	6 drams every 2 hours.	Every 2½ hours.
Four weeks	2 ounces every 2½ hours.	Twice at night.
Three months	3 ounces every 3 hours.	Once at night.
Five months	4½ ounces every 3 hours.	No night feeding.
Nine months	6 ounces every 4 hours.	" " "
One year	8 ounces—4 feedings.	" " "

The **strength of the food** is gradually increased at the same time, beginning, during the first week, with a weak formula, such as 2, 5.50, 0.60, and increasing as the diges-

tion will bear it, until, at one year, the child can take cows' milk undiluted. If the child is tranquil, gains steadily in weight, and has well-digested stools, the food is agreeing with it and requires no alteration.

If the weight is not increasing sufficiently, usually a stronger formula is prescribed, or a formula with a larger proportion of sugar.

After the ninth month starchy foods may be ordered. Proprietary foods should, however, be looked upon with suspicion; as a rule, they are deficient in fats, which are a prime necessity for the infant.

Indigestion may be shown by colic, vomiting, or by abnormal stools, all of which are important points to observe.

Regurgitation and vomiting may also be caused by feeding too quickly, or in overlarge quantities.

Protein indigestion is shown by colic, vomiting, diarrhea or constipation, and the presence of curds in the stools.

Carbohydrate indigestion is shown by colic and thin, green, acid stools that "scald" the buttocks.

Too much fat causes vomiting toward the end of digestion, and frequent stools, either of normal appearance or containing fat. Too little fat is the commonest cause of constipation.

EGGS

Eggs rank next to milk in forming a nourishing, easily digested food for the sick. They contain all the food elements except the carbohydrates, and are rich in mineral salts. The salts are present in "organic combination," which make them readily assimilated by the body. The white of egg is almost pure albumin and water, and is more easily digested than the yolk, which is a highly complex food-substance, containing fat, protein, and a large number of the mineral salts. The presence of sulphur is detected easily when an egg begins to decompose. The white or yolk may be used separately or together, and either raw or cooked, measured by bulk. Eggs contain a much larger amount of nourishment than milk. Where the digestion is feeble, the white of an egg dissolved in cold water is one of the simplest forms of nourishment, and generally well borne. (See Recipes.)

The first quality of an egg is that it should be fresh, and especially so when taken raw.

To be perfectly fresh, an egg should not be more than twenty-four hours old; in hospital work, however, it is commonly impractical to obtain eggs the day they are laid. The freshness may be maintained for a considerably longer time if eggs are properly cared for. The egg-shell is porous, and in course of time some of the water in the egg evaporates through the shell, the place of which is taken by air from outside. We see the effect of this in the little air-space at the top of a boiled egg. If the egg is new laid, the space is very small; in an older egg it is considerably larger. The entrance of the air, which may also mean the entrance of bacteria, is the cause of the decomposition. Air may be excluded in several ways, but it must be remembered that the material used will readily impart the taste to the egg. To keep eggs for immediate use as fresh as possible the shells should be clean, and they should be kept at a low temperature in the larder or ice-chest, away from all strong-smelling foods, such as cooked meat or vegetables.

When used, each egg should be broken separately in a cup, as one turned egg will cause a whole dish to be spoiled.

The albumin of eggs coagulates at a temperature of 134° F. If exposed to high temperature, the albumin is tough and leathery, less palatable, and more difficult of digestion. They should, therefore, in most cases be cooked slowly at a comparatively low temperature (134° to 167° F.). The yolk will cook at a lower temperature than the white.

The digestibility of eggs is also increased by beating; this ruptures the fine capsule which incloses the particles of albumin, setting the albumin free to be acted upon by the gastric juice. (See Recipe.)

GRUELS

Gruels, when combined with milk, are rich in nutritive value, and form usually a much-appreciated variety in the monotony of a restricted diet. Oatmeal, wheat-meal, bar-

ley-meal, rice, and other prepared cereals may be used. Oatmeal gruel has a laxative effect, and is, therefore, preferred where active elimination is desirable. Barley gruel and rice gruel have astringent properties, and are preferred in cases of intestinal irritation.

In cooking cereals it must be borne in mind that long exposure to heat is necessary, in order thoroughly to rupture the cellulose inclosing the starch-grains, and for the purpose of partially dextrinizing the starch. Patent invalid foods are frequently used instead of the cereals in the preparation of gruels. In them the starch is usually already dextrinized, and less time is, therefore, required for the cooking.

We have seen that long exposure to heat destroys some of the nutritive value of milk; milk or cream, therefore, is usually added at the end of cooking.

Since heat also converts cane-sugar into glucose, thus losing much of the sweet taste, if sugar is desired, it should be added on serving. The cereals are, however, rich in carbohydrates, and sugar should not be required.

Salt should be used for seasoning, and will aid in digestion.

Gruels must be served hot; they should be sufficiently thin to be drawn through the feeding-tube.

MEAT BROTHS AND EXTRACTS

Beef-tea, beef-juice, chicken-tea, and mutton broth are frequent additions to a liquid diet. They contain some soluble albumin, mineral salts, a little fat and *meat extractives*, and a large proportion of water. The nutritive value of meat-teas is not high, but the meat extractives act as stimulants to the gastric juice, and contain, besides, active principles, much like the alkaloids of vegetable drugs, which have a stimulating effect on the nervous system. Both as a general stimulant, therefore, and as a stimulant to the appetite, meat-teas and extracts are of value. They furnish, besides, an acceptable change in a monotonous, restricted diet. The nutritive value is increased by the addition of toast, croutons, crackers, or well-boiled rice.

It is on account of the stimulating effect of the meat extractives on the gastric juice that a hot meat soup is usually the first course of a heavy meal.

In preparing beef-tea or beef-juice the lean meat from the round of beef is used; for mutton broth, lean meat is cut from the forequarter of lamb or tender mutton, the skin and fat removed, and the meat cooked with the bones; for chicken broth the whole chicken is used, with the skin and fat removed. Where the digestion is delicate, fat, especially meat fat, will often cause digestive disorders, and should, therefore, be avoided. In order to extract all the nourishing properties of the meat-juices, meat to be used for broths or teas should be cut up in small pieces and placed in *cold* water, which is then slowly brought to the temperature necessary for cooking. (See Recipe.)

WATER

The value of water in a dietary must not be overlooked. As a solvent, a diluent, and as an aid to elimination no food-stuffs can take its place, and although it is considered that water does not undergo combustion, but passes out from the body still as water, it is certain it has an influence, probably nearly as important as that of oxygen, on metabolism.

On an average, from four to six pints of fluids should be taken daily in the form of drinking-water, beverages, soups, and milk. In disease, where the ordinary processes of nutrition are impaired, a certain amount of water should be given daily over and above that represented by the liquid diet, remembering that water in a pure state fulfils its own purpose in the body better than when combined with food-stuffs. The supply should not be left to chance, and given only when the patient complains of thirst, but be entered as part of the diet and given at regular hours.

Conditions where water should be pushed are: deficient elimination, either of bowel or kidney, toxic conditions, fevers, in rheumatism, gout, and other conditions associated with excess of uric acid, where much fluid has been lost to the body, as after severe hemorrhages, when the bleeding point has been secured.

Water is restricted where dropsy is present, in effusions of pleura or pericardium, and in conditions where it is desirable to promote the clotting of the blood, as in aortic aneurysm or hemorrhages, where the local lesion cannot be reached. Fluid is also restricted in the condition of dilated stomach.

Besides its general purposes, water may be used as an aid to digestion.

Hot water acts as a stimulant to the gastric juice, and is a useful aid to deficient elimination, especially in bilious conditions.

A glass of hot water ten minutes before meals is frequently prescribed in conditions of chronic gastritis. It washes the stomach free of mucous secretion, and promotes the secretion of the gastric juice.

Cold water has the important effect of exciting peristalsis, and for this reason is often ordered night and morning in the treatment of constipation.

Either boiling hot water or iced water (or ice) in small sips is useful in relieving nausea and vomiting; hot water is most valuable in nausea after an operation, as it also allays thirst, which ice or ice water frequently appears to increase.

The carbonated waters—soda-water, seltzer, Vichy, etc.—are often preferred by patients to ordinary drinking-water, and are, as has been said, especially useful in the dilution of milk. Soda-water is often found useful in checking vomiting. Their only disadvantage over plain water is that they tend to produce flatulence.

Many of the natural mineral waters are useful for special properties in the aid of elimination, and are not used as beverages; such are Hunyadi water, Apenta, and others. Others, such as lithia water, are valuable in conditions associated with uric acid, and may be taken more freely.

BEVERAGES

Where it is difficult to induce a patient to take a sufficient amount of fluid, he may often be induced to do so by offering it in the form of a beverage with an agreeable flavor or appearance.

The beverages most universally used and constantly craved by patients are hot *tea* and *coffee*. Both are refreshing, stimulating, and cheering, and to some extent both diuretic and diaphoretic. Taken at night, they cause wakefulness, and the abuse of either induces a condition of nervousness not unlike the abuse of alcohol and tobacco.

Unfortunately, both tea and coffee are apt to produce disorders of digestion, and are, therefore, not usually included in the diet of very sick persons or invalids of weak digestion.

Tea.—The indigestibility of tea is due to the tannin. Tea may be prepared with a minimum amount of tannin in the following manner:

Place two teaspoons of tea in a small pot, previously well heated; add just sufficient boiling water to cover the leaves, cover, and let stand for three minutes; pour off the tea into a heated cup, and add sufficient boiling water to dilute; sugar and cream or lemon may be added.

By this method the thein (the active principle of tea), which is readily dissolved, is extracted and forms a saturated solution which will not pick up the more slowly dissolved tannin. In any case the longer the water stands on the leaves, the more tannin will be extracted. Freshly made tea that does not stand more than three minutes before being poured off the leaves should be the rule in the sick-room.

The tannin in tea checks digestion; strong tea is, therefore, an unsuitable beverage to take with a heavy meal, and its use in this respect is a common cause of dyspepsia.

Coffee, if taken in excess, is apt to produce nervousness, insomnia, and biliousness. It contains an oil which is the cause of its bilious effect, but also produces a slightly laxative action on susceptible people. Black coffee is a good general stimulant, and useful in cases of lowered vitality; it is frequently given by enema in conditions of shock and collapse. A small quantity of black coffee at the end of a meal is considered to aid digestion.

The best coffee is made by the drip method, from freshly

ground beans. The flavor is spoiled if it is allowed to boil. Coffee for the sick-room should be freshly made.

Coffee and tea have no food value, except in so far as milk, cream, or sugar may be served with them.

Chocolate and **cocoa** are rather foods than beverages, since they contain carbohydrates, fats, and proteins, besides a stimulating principle, theobromin, and represent considerable nutritive value.

Beverages made from fresh fruits and fruit syrups are refreshing and easily made. The sugar and the vegetable acids they contain give a small proportion of food value.

Starchy beverages are frequently ordered in cases of intestinal irritation; the most important are barley-water and rice-water. They have a slightly astringent effect on the mucous membrane of the intestines.

The value of **alcoholic drinks** in illness is largely a matter of opinion, and is governed by many considerations: the previous habits of the patient, the necessity for stimulation, the state of the digestion, and so forth. They belong to the physician rather than to the dietitian, and in illness are practically medicines. Hot alcoholic drinks, such as whisky toddy, have a quick diaphoretic effect and are useful in the breaking up of a cold. They are also valuable where much of the body heat has been lost from exposure or fatigue.

CHAPTER XXIII

DIETS AND DIETING

General Division of Diets—Selection of Diet—Liquids—Eggs, Meats, Fish, Vegetables, Fats, Carbohydrates—Some General Points—Diet in Special Diseases: Fevers, Typhoid Fever, Acute Gastric and Intestinal Disorders, Gastric Ulcer, Diarrhea, Infantile Diarrhea, Chronic Dyspepsia, Dilated Stomach, Obstruction of Bile-ducts, Chronic Constipation, Nephritis, Dropsy, Salt-free Diet, Diabetes, Phthisis, Scurvy, Rickets, Anemia.

GENERAL DIVISION OF DIETS

In hospitals where the diets are not prescribed individually by the calories required, as explained in the preceding chapter, the patient's food is usually ordered under the heading of certain standard diets, except in cases requiring special dieting. The usual divisions are milk diet, liquid diet, semisolid diet, house diet, house diet with care, and extra diet. The quantities are prescribed, and the nurse's chief responsibility is to see the patient gets the right amount, properly served. In private work a nurse may find herself left much more to her own resources, both as to the selection of food and the quantities in which they may be given. She may have no more precise orders than "a light, nourishing diet," or "keep him on liquids"; it is then very essential that she should know the average quantities necessary, and the forms in which foods are most easily digested.

If she has been taught thoroughly the chemical composition of food-stuffs and their caloric values, she will obviously bring a trained intelligence to bear on the subject that will both aid her in her work and benefit her patient. A nurse is, in fact, not fully equipped without this knowledge.

Liquid Diet.—This includes milk, buttermilk, whey, cocoa, chocolate, egg-albumen, broths, bouillons, barley

and rice water, thin gruels, and beverages. From four to six pints are the average allowed. Where milk is taken, generally two-thirds of the diet should be milk; of the remaining third, one-half should contain nourishment, as in broths, egg-albumen, and gruels, and one-half be pure water or beverages. Where milk is the only diet, the form in which the milk is given should be varied. Few patients can take more than three or four pints of milk in the day. Extra liquid to relieve thirst should be given as water or beverages without food-stuffs. The whole quantity should be divided into feedings, and given at regular intervals. In a sick diet not more than 5 ounces of plain milk should be given at a time; of diluted milk, broths, etc., not more than 10 ounces; thin gruels, from 5 to 8 ounces; beef-juice, $\frac{1}{2}$ to 1 ounce. Whole milk may be diluted with carbonated waters, lime-water, etc., as above. The most digestible forms of milk are whey, buttermilk, and fermented milks (koumiss, etc.). Where cream is well borne, it is of great use on account of its high caloric value.

Broths and bouillons made from beef are more irritating to the intestinal tract, on account of their extractives, than those made from mutton or chicken. They should be made from lean, tender meat, with all fat carefully removed. (See Recipe.) It must be remembered that broths, bouillons, and beef-extract preparations are valuable chiefly as stimulants to the digestion, and as affording variety to a monotonous diet, and contain little of nutritive value. Egg-albumen and gruels are foods and have distinct caloric value. As meat extractives are to some extent irritating to the alimentary tract, they are often useful in overcoming constipation, and are contraindicated, as a rule, in conditions associated with diarrhea.

In any case of gastric or intestinal disorder liquids should be given cool: either very hot or very cold drinks tend to aggravate the trouble.

Even a fluid diet may cause indigestion, the symptoms of which may include nausea, vomiting, flatulence, distention, coated tongue, and diarrhea or constipation, the latter symptoms especially from an exclusive milk diet. Most commonly it is the proteins that cause digestive

troubles, especially the casein of milk. The milk may be altered or diluted, as already described; lime-water or bicarbonate of soda may be added, with the object of making the curds less heavy, or the protein may be predigested by a peptonizing agent. Another method of helping the enfeebled digestion is by giving regularly, in small doses, dilute hydrochloric acid (3 to 5 minims), or some preparation of pepsin, thus supplying the gastric juice artificially with what, in a normal condition, is called forth by a mixed diet. The use of a small amount of table-salt in the milk is also a valuable aid to digestion.

The return from a liquid to a solid diet must be gradual. A long continuance of fluid or bland food-stuffs renders the stomach unaccustomed to digest solids, and a short time must elapse before the gastric juice becomes reëstablished in its normal condition. The diet should be increased first by easily digested foods, such as gruels, cocoa, soft-boiled eggs, junket, farinaceous puddings, baked potatoes, oysters, and so forth. The stools should be examined to insure that the food is being well digested.

Eggs.—Eggs are most digestible if taken raw, either plain or as eggnog, or soft boiled. Taken with an ordinary liquid diet, two to four are usually given in the twenty-four hours, except in cases of forced feeding. Fried eggs, or eggs cooked with butter, must be avoided in all disorders of the digestion.

Meats.—The most digestible meats are those containing least fat or gristle; young meats are tenderer than meat from older animals, and white meat than dark meat. Red meats, especially beef, are irritating on account of the extractives, and are, therefore, not generally given where the digestion is feeble. Meat may be made more digestible by being finely divided, as in mincing or scraping. The most digestible meats are sweetbreads, white meat of chicken, pigeon, and tripe. Where red meat is ordered, broiled lamb-chops or tenderloin steak are best to begin with.

Meat is usually tenderest and most palatable if lightly broiled or roasted; boiling is permissible with chicken or mutton if it is impossible to get young meat. Fried meat

should never be given in the sick-room. Gravies and seasoned sauces should also be avoided. Commonly speaking, meat is best given at the midday meal; if preferred at the evening meal, at least three hours should intervene before bedtime.

Fish.—The fish to be avoided are those containing much fat—salmon, mackerel, herring, bluefish, and shad. White fish, such as whiting, flounder, carp, halibut, white-bait, and others, are suitable. They are more digestible boiled, broiled, or scalloped. If fried, all grease must be carefully removed. Oysters and clams may be eaten raw or stewed; in this way they are more digestible than if panned or fried.

Vegetables.—The most digestible vegetables are those with the least amount of cellulose. Cabbage contains a large amount, and elaborates much gas during its digestion. Peas and beans tax the digestion considerably, both from the amount of cellulose they contain and also from the large percentage of protein. The vegetables must be very young and cooked until soft. Potatoes should be well cooked in order partially to dextrinize the starch; they are most digestible baked or thoroughly mashed. Coarse vegetables, cabbage, turnips, carrots, onions, and radishes should be avoided in the sick room. The most digestible green vegetables are asparagus-tops and the *flower* of cauliflower. They should be well boiled, and eaten without seasoning, except salt. Fruits are usually acceptable, and, although not nutritious, they are refreshing and please the appetite. On account of the acids they contain they should not, where the digestion is delicate, be taken with milk. Where the digestion is weak the juice only should be given. Grapes, orange-juice, and lemon-juice may usually be given freely. Peaches, pears, grape-fruit, and berries must be given with more discretion. All fruits must be thoroughly ripe and perfectly fresh.

Carbohydrates.—In a liquid diet carbohydrates are given in the form of barley-water, rice-water, and thin gruels. Where more solid food is taken, bread, rusks, toast, well-cooked cereals, and farinaceous puddings are the usual means. All starchy food must be cooked slowly

and thoroughly, in order partially to dextrinize the starch and so spare digestion.

Hot bread, hot buttered toast or cakes, and scones, etc., made with butter or served hot with butter, are difficult to digest. The melted butter surrounds the starch grains, and prevents any action of the digestive ferments, until the fats have first been acted upon.

Fat.—Where the diet is liquid, fat is given, either in whole milk or cream, and is an important part of most diets. To convalescents an increase of fat is best given as butter, with toast, bread, etc., and in the fat of cooked meats. Chocolate may also be ordered for the fat it contains. Speaking generally, fat should not be used in the cooking of meals in the sick room, either in the form of butter, dripping, or oil.

SOME GENERAL POINTS

A few working rules a nurse may bear in mind concerning the diet of her patients:

See that the food is ready punctually, and served at regular intervals: the intervals should be sufficiently long for the stomach to have a period of rest, and not long enough for the patient to become in any degree exhausted for want of food.

Insist that all solid food be properly chewed and eaten slowly.

Remember that food is better digested if it is liked; tempt the patient's appetite with variety, small surprises, and dainty service. Worry, temper, and overexcitement affect the digestive processes: see that the atmosphere of the sick-room is pleasant during mealtime.

Allow sufficient time for digestion between the last meal and bedtime, since the digestive processes are sluggish during sleep.

Serve hot foods very hot and cold foods really cold; avoid either extreme of temperature, especially hot or ice-cold fluids, in all cases of gastric disorder, especially if associated with diarrhea or ulcerated conditions.

Omit altogether, in the diet of the sick, spices, seasonings, rich gravies and sauces, and fried foods.

In giving liquids to patients in bed use either the feeding cup or, as is generally preferred, a glass tube bent to a convenient angle. If neither is procurable, pour a small quantity at a time into a tumbler, and raise the head slightly by passing the arm under the pillow.

A patient in a stupor may be given liquid food with a spoon; the mouth is opened by pressing the chin downward or by pressing the cheek on either side against the back teeth, using the finger and thumb of the left hand. The food is passed to the back of the mouth, pressing the tongue gently down with the spoon, and will generally be swallowed.

Where the patient cannot be induced to swallow, he may be fed through the nose with a medicine-dropper, passing the dropper into the nostril and directly backward. The liquid will trickle directly into the pharynx, and usually be swallowed. For patients in this condition gavage is generally preferred.

A baby should be taken on the arm, or turned on its side in its cot, and given its bottle *slowly*, with a little pause from time to time. Many babies learn to bolt their food by being left to take their bottle alone; others, that are slow feeders, leave their bottles until they are cold, or neglect to take the whole amount. A young baby should never be left to take its bottle alone.

DIET IN SPECIAL DISEASES

At the present day the question of diet in the treatment of disease, and especially of the more chronic varieties, has assumed an immense importance. In many respects scientific dieting is still in the experimental stage, and nurses must be prepared to meet with contradictory opinions and varying methods.

In the large majority of diseases we meet the need for some alteration in the normal diet. The diet may be altered to suit the requirement of a special organ, as when we decrease the proteins where the kidneys are diseased, or the carbohydrates in cases of diabetes. All toxic conditions are accompanied by digestive disturbances; food must, therefore, be given in these circumstances in its

simplest and most digestive forms, and, at the same time, it must frequently be contrived so as to increase its caloric value. The most common condition in which strict dieting is a principal part of the treatment is in disorders and diseases of one or other part of the digestive tract.

A diet is succeeding when it is bringing about the effect for which it is prescribed. If the kidneys are improving, there will be less albuminuria and fewer casts in the urine; under a strict diabetic diet the excretion of sugar in the urine is controlled, and so forth; for special conditions the nurse must watch special points for the results. For general purposes, a diet is agreeing with a patient when he increases in weight, or, at least, in an adult, does not lose weight, is placid in mind, digests his food, shows a reasonable appetite, and the excreta are normal. The consistence and appearance of the bowel movements are the most important indications of the satisfactory digestion of a diet; in cases of disordered digestion, from whatever cause, and in any case of special dieting, their inspection should never be left to inexperienced persons.

It is only possible, in a book of this size, to take, as examples of special dieting, the diseases most frequently met with, in which strict dieting is a prominent part of the treatment.

Fevers.—The condition we know as fever most commonly is the result of the presence of toxins in the body (Chap. XX); it is always associated with certain phenomena—raised temperature, prostration, waste of the tissues, loss of appetite, and derangement of the natural processes of digestion and metabolism. The diet to combat these conditions must contain all the food elements, must be sufficient to combat to some extent the tissue waste, must be nourishing, easily digested and assimilated, and should include a large supply of water. Taken in sufficient quantity water acts as a diluent to the toxins, and also furthers their elimination by the natural excreta. It is given freely in all fever cases unless contraindicated by other conditions, such as general dropsy or effusion of one of the serous cavities.

A liquid diet is the most suitable for this condition, such as has been described. The diet may be exclusively of milk, or varied in the ways suggested. If diarrhea is a symptom, the milk may be ordered boiled, diluted with lime-water, or given with equal parts of barley-water. In certain conditions, to be described presently, milk may be withheld altogether.

When constipation is present, milk may be given with a larger proportion of cream, or diluted with the natural waters or with thin oatmeal gruel; broths and bouillons may also aid in overcoming this condition by their stimulating effect on the alimentary canal.

In the mild fevers that accompany, for example, the common cold, bronchial catarrh, etc., hot drinks and hot gruels may be added, with the object of encouraging sweating.

Typhoid Fever.—Until very recent times typhoid fever was one of the most common diseases to be met in every medical ward, and the correct nursing of a typhoid patient was a classic ground for teaching certain important points in nursing, especially dieting, the handling of helpless patients, and the practice and principles of disinfection. At the present date this fever is rarely encountered in America; inoculation and other methods of prophylaxis apparently are succeeding in stamping it out as vaccination, half a century ago, reduced the number of smallpox victims to a negligible amount. It is, however, too early to omit from a nurse's training instruction in the care of typhoid patients, almost the entire treatment of which lies in careful nursing.

In typhoid fever we have some special conditions that must be taken into consideration in the dieting. We have an infection that develops slowly, produces a profound toxemia lasting over a considerable length of time, and is characterized by a rapid waste of the tissues and marked prostration. Further, typhoid fever is associated with ulceration of certain glands in the walls of the small intestines; in severe cases these ulcers burrow deeply into the wall of the intestine, and irritation of these parts from decomposition of food particles or distention of the walls

from gases so elaborated may result in rupture of a blood-vessel so exposed, or in perforation, where the walls of the vessel have been worn thin by the burrowing ulcer.

In choosing the diet, we must have one that will counteract the tissue waste, put the body in the best condition to resist the prolonged attack of the invading infection, and, at the same time, will not overtax the deranged digestion or leave an indigestible residue to irritate the intestinal ulcers.

For many years the classic diet for all typhoid cases was a strict liquid diet, composed chiefly of milk, diluted with Vichy or lime-water, to which strained chicken and mutton broth and beef-tea were added, provided there was no diarrhea nor very acute toxic symptoms which would suggest extensive ulceration. The diet suited the gastric condition, but did little to combat the tissue waste or the prostration, which in themselves may be a menace to life.

At the present day our ideas on diet have been much modified by the more definite knowledge available on the comparative value of the different food-stuffs as *energy-producers*, as we saw in a previous chapter. We saw (Chap. XXI) that the diet of a man of average weight in normal conditions should yield, roughly, between 35 and 40 calories for each kilogram of his body weight, which energy he uses up in functional and motor activity and in the repair of the tissues.

In typhoid fever we have, although we keep the body at rest, a waste of tissue out of all proportion to what could be caused by any physical activity, and an abnormal heat-production due to the febrile condition. We have, therefore, a condition in which an increased amount of energy is used up, and should be counterbalanced by an increased number of *calories* in the diet; at the same time we have an enfeebled digestion and an irritable alimentary tract. It is estimated that the average typhoid-fever patient requires an increase of 25 per cent. calories in his diet, in order to combat the tissue waste and the loss through the abnormal heat-production, and to increase his resistance to the infection. It is a condition, then, in which a *high caloric diet* is of special value; at the same time the diet must be

chosen to throw a minimum of work on the enfeebled digestion.

In whatever school the nurse works at the present day she will probably find some scheme or schedule for the high caloric diet of fever patients, and the accurate administration of such is almost the most important part of her share in the care of the patient.

The patient is weighed regularly, frequently daily, and every article of his diet must also be weighed and measured. As many fever patients display little appetite, much tact, discretion, and perseverance may be called for in inducing the patient to take the necessary amount.

The number of calories prescribed depends on the weight of the patient; the average high caloric diet allows from 60 to 80 calories for each kilogram of the patient's weight, and in special cases an even higher number is given. If the diet is successful after the first week, the patient gains steadily in weight—often as much as three pounds and over in the week.

In all the schedules cream, eggs, milk in some form, milk-sugar, and, usually, butter are the staple articles of diet. Eggs are most digestible if taken soft boiled; milk-sugar is used instead of cane-sugar, as, being only half as sweet, a much larger quantity can be given in the diet. The sweet taste is further lessened by cooking. If the sugar is to be added to uncooked foods, such as fruit-drinks, it may first be boiled in water for two minutes. The quantity of each of these foods necessary to furnish 100 calories is as follows:

White of eggs	5
Yolks	2
Cream (20 per cent.)	45 c.c.
Milk	150 c.c.
Whey	180 c.c.
Milk-sugar	45 gm.
Butter	15 gm.

To the above are added well-cooked cereals,—oatmeal, hominy, or wheatena,—corn-starch and tapioca puddings, custards, ice-cream, wine and fruit jellies, toast, stale bread or simple crackers, with which the patient is induced to eat as much butter as possible. Milk-sugar is used in

the cooking, as well as taken with the milk, cream, and other drinks. It is given in small quantities at first, not more than $\frac{1}{2}$ ounce, and gradually increased until from 4 to 6 ounces can be taken in half a pint of fluid. Cream is given pure or diluted with milk, etc., as well as served with various foods. Coffee or tea with cream and milk-sugar or cocoa is served with the morning meal. Some doctors add to this diet scraped beef, finely minced chicken, and boiled whitefish or beef-juice; others omit meat or meat-juice entirely during the acute stage.

When the digestion is abnormally sensitive, the diet may be exclusively of cream, milk, and milk-sugar; usually, however, the more mixed diet is well borne. If the patient shows symptoms of indigestion, such as vomiting, diarrhea, or the presence of curds in the stools, he may be given peptonized milk for a short period, until the digestion is reëstablished, when the diet is gradually resumed.

Patients are usually given their three principal meals as breakfast, dinner, and supper, with additional feedings either every two or three hours, according to the amount of nourishment necessary and the quantity the patient can take at a time. At the beginning the quantity taken may be small, but should be increased perseveringly. During the night only liquid food is given. Water should also be taken, and may be given with fruit-juice, sweetened with milk-sugar, if there is difficulty in getting in the full amount of calories.

A diet scheme in one of the leading hospitals gives, in the daily diet, an average of 1 to 2 pints of cream, 2 to 3 pints of milk, $\frac{1}{2}$ to $1\frac{1}{2}$ pounds of milk-sugar, from 3 to 6 eggs, and as much butter as the patient will eat with stale bread or toast.

When the temperature falls, solids are added to the diet, beginning with baked potatoes, sweetbreads, finely minced chicken, and broiled squab, and, finally, broiled chop and tender steak as the digestion is accustomed to the increased diet.

Throughout the whole course of the illness the stools should be inspected by an experienced person, to insure that the diet is being well digested.

Gastric and Intestinal Disorders.—No special rules or diet-lists can be laid down for the treatment of gastric or intestinal disorders which will cover all cases. It may be assumed that in no class of disease is it more necessary that the patient should seek the advice of a specialist on this point. Not only may the individual case vary greatly, but general symptoms, apparently similar, may proceed from opposite causes, and the diet that may benefit one will aggravate the trouble in another. Again, under treatment, the gastric conditions change from time to time, demanding that the effects of the diet should be carefully watched, and the diet itself modified accordingly.

Many stomach specialists use certain diet-lists as a routine treatment in given conditions, and these are available in various text-books. A nurse should be very careful not to encourage the use of such lists except under expert advice, since, without accurate knowledge of the condition, even careful dieting is merely hit or miss. To take a case in point: In gastric disorders the gastric juice is, to a greater or less extent, changed. There may be an increase of acidity, or there may be a decrease or even an absence of acidity (p. 218). The symptoms that are, however, apparent to the patient or the nurse may seem to be the same in either case. Obviously, the diet that will suit one case will not be best suited to the other. In the first case, since the use of the hydrochloric acid is in the digestion of the proteins, the excess of acid may be in some cases counteracted by a diet in which the proteins are pushed at the expense of the carbohydrates; in the second, protein digestion is faulty; the protein foods are given sparingly, in the most digestible forms, and their place largely taken by carbohydrate foods and fats. In other cases it may be the muscular power of the stomach that is at fault, as in dilated stomach. In this condition the restriction of fluids is a most important part of the diet, and a diet, however digestible, in which broths and milk are given freely may simply increase the disorder.

The object of a special diet in these conditions may be put briefly as a means of giving the body the amount of nourishment necessary, with the least possible work for

the faulty digestive organs; whatever part of the digestive tract is out of order, therefore, must be given the least amount of work. At the same time the five food-elements must be represented.

Here again the importance of an estimation of the caloric value of a given diet is demonstrated, so that the best results may be obtained with the least work for the digestion. Usually, 35 calories for each kilogram of the weight is allowed if the patient is confined to bed, or 40 if he is about doing light work. During the entire treatment the patient must be regularly weighed.

In the *acute stage* of any gastric disorder the first aim is to give the digestive tract as little work as possible, frequently at the cost of temporarily starving the body.

In *chronic conditions*, especially where the patient is about and leading an ordinary life, it is necessary that he should have the amount of food to keep up his body weight, which is the practical sign that the body is getting and using its due amount of nourishment.

Acute Digestive Disorders.—In any acute gastric or intestinal condition we begin, probably, with a period of starvation, following which food in its most digestible form is given, *i. e.*, milk and milk preparations, broths, and egg-albumin, and finally, solid foods are gradually added as they can be borne. The choice of diet is governed by local symptoms. Thus, if diarrhea is present, foods with a constipating quality are necessary until the condition is arrested. Such are boiled milk, milk with lime-water, corn flour or arrowroot gruels, barley-water or rice-water —the two latter for their mildly astringent action. If constipation is present, buttermilk or whey is preferred to milk; and, as a rule, fats in some form will be ordered, probably as cream.

Gastric or Duodenal Ulcer.—In nursing these cases there are two standard forms of treatment with which a nurse should be familiar, as they form the basis of most present-day treatment. They are known respectively as the *Lenhartz diet* and the *Sippy diet*. The latter is the more recent method and at the present day is probably the accepted standard of treatment in America.

In the true Lenhartz diet the patient is given food by mouth from the beginning even where there is hemorrhage. In America it is more usual to begin by a short period of starvation, perhaps forty-eight hours, during which small enemata of saline solution ($\frac{1}{2}$ to 1 pint) are ordered every four or six hours. Some doctors also give rectal feeding of predigested food in conjunction with the mouth-feeding until the patient is taking sufficient nourishment. In the Lenhartz treatment the stomach is never entirely empty except at night, the theory being that the gastric juices are less irritating if in conjunction with bland food-stuffs.

The Lenhartz treatment is carried over a period of two weeks. Beginning with a minimum quantity of raw egg and milk, one raw egg and 100 c.c. of milk are added daily until 12 eggs and 1000 c.c. of milk are taken. To this diet sugar, scraped beef, boiled rice, soft toast, ham (or chicken) minced, and, lastly, butter are added on regular days, each beginning with a minimum portion gradually increased.

The following table, taken from the dietary of the Peter Bent Brigham Hospital, Boston, explains the way this diet is carried out. In some minor respects it differs from the original Lenhartz diet scale.

Day.	Eggs.	Milk.	Sugar.	Scraped Beef.	Rice.	Toast.	Ham.	Butter.	Calories.
		C.c.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	
1	1	200							212.45
2	2	200							286.05
3	3	300							429.75
4	4	400	20						653.00
5	5	500	20						796.25
6	6	600	30						979.05
7	7	700	30	35					1185.04
8	8	800	40	70	100				1541.00
9	9	900	40	70	100	20			1768.71
10	10	1000	50	70	200	40			2146.12
11	11	1000	50	70	200	40	50	20	2515.17
12	12	1000	30	70	300	60	50	40	2857.18

The food each day is divided into so many equal portions. For example, for the first day the raw egg is beaten and divided into six portions and placed in separate

medicine measures on ice; the milk for the day is also measured and kept on ice. The feedings of milk and eggs alternate. The patient is spoon fed and allowed to make no exertion whatever for himself. The first days the eggs may be salted to taste; when the sugar is added it is given (also divided in equal portions) with the egg feedings. From the eighth day four of the eggs are taken soft boiled. Scraped beef and rice are each divided in three feedings and may be taken together; the toast is given first at two feedings then at four, and from the twelfth day at each feeding. The butter may be taken with the toast or with the boiled rice. The chopped ham (other hospitals use chopped chicken) is given in two portions, one in the middle of the morning and one at 5 P. M.

It is usual in hospital work to prepare a set of cards covering the diet days; the card is placed with the patient's chart and order sheet and changed daily. The following is a sample of such a diet card for the first and twelfth days of the above diet:

Day 1:

Food.	Amount.	Protein.	Fat.	Carbohydrates.	Calories.
		Gms.	Gms.	Gms.	
1 Egg........	50 gms.	6.7	5.25		74.05
Milk.........	200 c.c.	6.6	8.00	10	138.04
	Total......	13.3	13.25	10	212.09

Day 12:

Food.	Amount.	Protein.	Fat.	Carbohydrates.	Calories.
12 Eggs......	600 gms.	80.04	63.00		889.68
Milk.........	1000 c.c.	33.00	40.00	50.00	692.00
Sugar........	30 gms.			30.00	120.00
Scraped beef..	70 "	14.62	7.42		125.03
Rice.........	300 "	8.04	.03	73.02	329.01
Toast........	60 "	5.88	5.94	44.01	253.38
Ham..........	50 "	10.01	11.02		141.02
Butter.......	40 "	.04	34.00		307.06
	Total.....	151.63	161.41	197.03	2857.18

By the fourteenth day the patient is ready for a convalescent diet, beginning with milk, soft-boiled eggs, soft toast or milk toast, purées of peas, potatoes or beans, jelly, custard or farinaceous puddings, and introducing

gradually boiled white fish, broiled chop or rare steak, roast or boiled chicken, and strained apple sauce, until an ordinary diet can be taken. Fried food is to be avoided, also coarse vegetables, gravies and condiments, and either ice-cold or very hot foods or drinks. The amount of food necessary to give the patient the right number of calories will be divided between the three principal meals, with a luncheon in the middle of the morning, between dinner and supper, and a little before bedtime.

The *Sippy diet table for gastric ulcer* following is from that in use in the Pennsylvania University Hospital:

The period of strict dieting lasts from eight to ten weeks.

First four days: From 7 A. M. to 7 P. M. give every hour $1\frac{1}{2}$ ounces of milk with $1\frac{1}{2}$ ounces of cream.

Fifth day: Continue the same diet, but substitute for one feeding 6 ounces of some semisolid—cereal, cocoa, custard, cream soup, junket, egg-nog, or soft-cooked egg.

Each following day replace one more milk feeding by another 6-ounce meal of semisolid diet.

As the patient shows tolerance gradually introduce solids into the diet, beginning with mashed potato, white meat of chicken finely divided, stewed fruits, well-cooked spinach, asparagus, and squash; raw fruits and vegetables and bread are avoided throughout the treatment.

The number of feedings are gradually reduced from every hour to every two hours, and finally to every three hours.

In connection with the Sippy diet table an alkaline is given at the half-hour between each feeding from 7.30 A. M. to 7.30 P. M. and every half-hour from 7.30 to 10 P. M. In the Pennsylvania University Hospital sodium bicarbonate, gr. xx, and bismuth subcarbonate, gr. x, is given alternately with sodium bicarbonate, gr. x, and magnesium oxid, gr. x.

In cases of **chronic gastric ulcer** the patient may be advised to restrict his diet entirely for ten days or so to milk, cream, and soft-boiled eggs. Following this, tapioca or corn-starch puddings are added for three or four days, after which the convalescent diet given above is suitable.

Diarrhea, Dysentery (Acute).—Before any diet is begun, the patient is purged and starved twenty-four hours; sips of tepid water may be given to allay the thirst, or ice may be slowly sucked, but even water should be as restricted as possible.

At the present day milk in any form is avoided during the acute stage, *i. e.*, as long as there is any pain, tenesmus, or rise of temperature. Albumin water and strained chicken or mutton broth are given—two pints in all in the twenty-four hours. Some doctors order tender, lightly broiled lean meat or scraped beef at an early stage. As the condition improves, well-cooked barley or rice or dry toast is added to the broths, skimmed milk, or whey; later, farinaceous puddings, tapioca, rice, etc.; soft-boiled eggs and rusks. When all symptoms have disappeared, butter and cream are added with caution, and the ordinary diet is gradually resumed, beginning with lean, finely divided meats in small quantities, and avoiding coarse vegetables, fried or seasoned foods, and extremes of temperature, especially in drinks.

Diarrhea in Infancy.—Diarrhea in young children is always an important symptom, even when slight; in its severe form, accompanied by high fever, acute colic, and rapid waste of the tissues, with profound prostration, it is one of the most fatal disorders of infancy. The treatment is largely dietetic.

Castor oil is usually given first as a purge, and all food withheld for twenty-four hours. Sips of tepid water may be given if there is no vomiting; if vomiting is present and thirst is excessive, the mouth is washed with weak lemon-juice and water, or shavings of ice are placed in the mouth. Lavage and enteroclysis of sterile water are also often ordered, or, if collapse is threatened, hypodermoclysis of normal salt solution.

Milk is avoided entirely—indeed, is looked on as actually poisonous. After twenty-four hours egg-albumen is added to the water, beginning with half an egg in twenty-four hours and increasing to two eggs if well borne. Small feedings (½ to 2 ounces) of well-cooked barley-water or rice-water are added as the condition improves. Of the next step

there are a variety of opinions: at present predigested foods in some form are in favor, such as malted milk, cereo-barley, Benger's or Mellin's food, and panopeptone in water. Milk is usually reintroduced first as whey, one feeding in the twenty-four hours. Peptonized milk with equal parts of barley-water is favored by some. Chicken and veal tea, with all fat carefully removed, are frequently ordered. Fat, in the form of cream, is not added until all symptoms have disappeared and convalescence is established. Many doctors withhold milk entirely for some weeks; others begin with a weak modified milk as soon as convalescence has set in, and gradually build up until the usual diet is resumed.

In older children the return to solid diet is made with chicken or veal tea, thickened with well-cooked barley or rice, or eaten with dry toast, soft-boiled eggs, and farinaceous puddings. Milk may be given, first boiled with rusks or toast. Fruit, vegetables, and cereals are withheld until the child is perfectly well, and butter used sparingly.

In all these cases very accurate records of the diet taken should be kept and charted with the records of the temperature, etc., the bowel movements, and the weight. The child is usually weighed daily. Every stool must be carefully inspected.

Chronic Digestive Disorders.—As has been said, it is impossible to lay down any rules for the diet of the large variety of *chronic* gastric or intestinal disorders. The object of dieting is to give food that will cause least trouble to the damaged part of the digestive tract, that will not aggravate existing trouble, and that, with a minimum amount of work for the digestive organs, the required amount of energy should be gained. At the same time, in order to get the digestion into perfect working order, it is probably necessary to tone the damaged part with light work, gradually increasing the work as the condition improves. It may be necessary to begin with predigested foods, either proprietary foods or peptonized milk, broths, or gruels. As a rule, these are dispensed with as soon as possible, in order to stimulate the natural secretions with a more normal diet.

The choice of food depends on the local condition, on the digestibility of the food, and on its caloric value. Practice may be given nurses in class, in making out for such cases varied diets of the most digestible food-stuffs containing the necessary calories.

Where hyperacidity is present, protein foods are usually ordered in excess to counteract the condition. All forms of lean, tender meat are given, eggs, and cereals and vegetables with a high protein percentage, such as oatmeal, and cornmeal, mashed potatoes, and purées of peas, beans, and lentils. Toast and rusks are the most digestible form in which white bread can be taken.

In cases of deficient gastric secretion the proteins are given sparingly and in the most digestible forms. The meats preferred are broiled sweetbread, broiled tenderloin steak, and white meat of young chicken, all in small quantities. The best cereals are wheat and rice, in which the percentage of protein is low; mashed potatoes and well-cooked asparagus-tips or cauliflower (flower only) are generally the vegetables preferred.

Milk is valuable in either condition, and pains should be taken to find the form in which it is most digestible. It should be taken between the heavier meals, with nothing more solid than a biscuit. Tea and coffee are frequently forbidden; if allowed, they should be weak, freshly made, and allowed to cool before they are taken. They should only be allowed with the light meals. Water is usually ordered between meals, and drinking altogether forbidden at the more solid meals.

Fat in some form is a necessary part of the diet. It is given as butter or cream, or sometimes as chocolate, but should be used very sparingly in the preparation of the food.

In these conditions the appetite is not a guide to the amount of food. Some patients loathe their food, others are ravenous and overload the digestion. The food should be carefully weighed and measured, and the patient gradually accustomed to the required amount.

The usual rule is to give small meals at frequent intervals, with the heaviest meal in the middle of the day.

Patients should eat slowly, masticate thoroughly, and rest for a short time after each meal.

Obstruction of the Bile-ducts.—In these conditions, as from gall-stones, inflammation, or organic disease, the bile may be greatly diminished in quantity or entirely absent from the digestive tract. In the diet for such a condition the *fats* are omitted, since, as we remember, the bile plays an important part in the digestion and absorption of fats.

Peptonized milk, buttermilk, whey, or skimmed milk diluted with natural mineral waters, are given during an acute attack. Hot water should be given freely; it helps to purge the alimentary tract, and counteract the constipation due to the absence of bile, and aggravated by the lack of fats. When solids can be borne, lean broiled meats, sweetbreads, whitefish, baked potato, crackers, and toasted bread are gradually added; fats, butter and cream, or fried dishes, should not be allowed until the patient is completely recovered.

Chronic Constipation.—The dietary causes of constipation are insufficient proportion of fluids, lack of fats and oils or organic salts, excessive use of alcohol, or the use of foods that are almost entirely digested (such as milk and eggs), and leave no residue to act as irritants to the intestinal walls and induce peristalsis. Water should be taken freely between meals, and especially at bedtime and before breakfast, cold water being preferred, as it excites peristalsis. The diet should include foods that leave some indigestible residue, such as oatmeal, cornmeal, whole-wheat and bran bread, coarse vegetables, berries, and figs; bland, non-exciting food, such as milk and eggs, should be restricted. To some people milk is constipating; on others it has a laxative effect, especially if rich in cream. Its use must be governed by the individual effects.

Olive oil taken regularly, a dessertspoonful three or four times a day, is often successful in relieving constipation, and almost all fruits are beneficial, especially apples and prunes. They are most efficacious if taken first thing in the morning. Alcohol should be given up. Tea may cause constipation, on account of the tannin it contains;

on the other hand, the amount of fluid ingested is helpful: coffee is preferable as a morning beverage, as it contains an essential oil. Buttermilk may be used as a beverage with good effect, as it usually acts as a mild laxative. Molasses and honey are also considered laxative, and may be given with whole-wheat breads.

Nephritis (Inflammation of the Kidneys).—As the excretion of urea and its elimination from the body is the function of the kidneys, it is not effectually performed where the kidneys are not in a normal condition of activity. If we give an ordinary amount of protein food in such conditions, we may cause the system to become overloaded with urea (which we remember is the residue of protein combustion), and we also further overtax the diseased kidneys. In all conditions associated with irritation or disease of the kidneys it is usual to give a minimum supply of protein food, in order both to rest the kidneys and to diminish the amount of urea formed in the body.

In acute cases of nephritis an exclusive milk diet is generally ordered; when it becomes necessary to reinforce this, carbohydrate food is added in the form of gruels, bread and butter, rice, and farinaceous foods. This is continued until the urine is normal, and shows, on examination, no trace of albumin. (See Urine.)

In chronic cases of nephritis it is not practical to reduce the protein foods permanently, and a more varied diet is necessary.

Foods which must be restricted or eliminated are red meat, eggs, and dishes cooked with egg; spices, condiments, and rich sauces are forbidden absolutely. The diet may contain fish, poultry (both preferably boiled), potatoes, and most vegetables except asparagus, celery, garlic, and leeks; fruit fresh and cooked; milk in any form, cream, and butter; cereals, bread, and cakes made without eggs, and simple desserts also without eggs. Tea, cocoa, simple beverages, and bland drinks are allowed, but the amount of fluid taken is strictly regulated and given under the doctor's direction.

Headache, vertigo, and disturbances of vision are some of the indications of an accumulation of urea, and when noticed the diet should be altered accordingly.

Diets for Testing the Kidney Functions.—Of recent years the use of test-diets in determining the functional powers of the kidney have come into use; by their means a diet is contrived in accordance with the degree of renal impairment shown in the individual case.

Most of the renal test-diets in use are adaptations from those of Drs. Hedinger and Schlayer; the one in most common use in American hospitals and in private practice is that adapted by Dr. Mosenthal for use in the Johns Hopkins Hospital.

The diet consists of three meals, each contrived from food substances known to be diuretic in character. All food is salt free and with each meal from 2 to 3 grams of common salt is served. Every item served is weighed or measured with great care, and any food fluid or salt not consumed is weighed or measured and noted.

The meals are served at 8 A. M., noon, and 5 P. M. No other food or fluid is taken in the twenty-four hours required for the test.

The Mosenthal diet table for the "two-hour test for renal function" is as follows:

Breakfast, 8 A. M.:	Boiled oatmeal	100 gm.
	Sugar, 1 to 2 teaspoons.	
	Milk	30 c.c.
	Bread, 2 slices	30 gm. each
	Butter	20 gm.
	Coffee 160 c.c., milk 40 c.c., sugar 1 teaspoon	200 c.c.
Dinner, Noon:	Meat soup	180 c.c.
	Beefsteak	100 gm.
	Potatoes boiled, mashed, or baked	130 gm.
	Green vegetables as desired.	
	Bread, 2 slices	30 gm. each
	Butter	20 gm.
	Tea 180 c.c., sugar 1 teaspoon, milk 20 c.c.	200 c.c.
	Water	250 c.c.
	Pudding, tapioca or rice	110 gm.
Supper, 5 P. M.:	Eggs (2) cooked as preferred.	
	Toast, 2 slices	30 gm. each
	Butter	20 gm.
	Tea 180 c.c., milk 20 c.c., sugar 1 teaspoon	200 c.c.
	Fruit stewed or fresh	1 portion
	Water	300 c.c.

The bladder is emptied at 8 A. M. before the first meal is served, and every two hours after till (and including) 8 P. M. Each specimen is put up separately—the hour, the quantity, and the specific gravity noted on the label. The night urine after the 8 P. M. voiding to 8 A. M. is collected as one specimen.

Dry Diet.—A diet in which the fluids are restricted and reduced to the minimum is known as a *dry diet*. It is favored by some doctors in the treatment of vascular heart disease, of chronic kidney disease, and for dilated stomach. The objects to be attained are different in each case. In heart disease the restriction of fluids is followed by a lowering of the blood-pressure; in kidney disease the work thrown upon that organ is directly diminished, since the amount of water excreted by the kidneys is in proportion to the amount taken into the system.

In cases of **dilatation of the stomach** the restriction of fluids is, for a local reason, an important part of the treatment.

In this disorder the cavity is dilated usually at the lower (and greater) curvature; below, that is, the pyloric valve, through which the gastric contents are passed on into the intestines. In consequence residues of food substances are apt to become lodged in the stomach, unavailable for nutrition, and giving rise to fermentation. Water, which is non-nutritious, fills up the stomach to no purpose, aggravating this condition and further weakening the lax action of the distended muscular walls. For these reasons restriction of fluids by mouth is the special feature in the diet of patients with *dilated stomach*. The food is given in small quantities of highly nourishing food substances at comparatively frequent intervals, the heaviest meal in the middle of the day, as in all cases of gastric disorders. The distress caused by the restriction of fluid in the system is, in these cases, often relieved by rectal infusion of plain water. In many cases lavage is a routine part of the treatment.

Salt-free Diet.—Salt, chlorid of sodium, is the one inorganic substance that is necessary to man. Not only is it an aid to digestion, but it has a definite and important effect on metabolism, especially in the absorption of fluids by the

tissues. In certain conditions a diet restricting, or eliminating for a time, salt from the food is a common form of treatment. In **epilepsy,** chlorid of sodium may be restricted in order to push the bromids, bromin and chlorin having the property of displacing one another in the tissues. Other diseases in which a salt-free diet may be prescribed are those associated with dropsy, or accumulation of fluid, in one or other of the cavities of the body, as *pericarditis, pleurisy,* or *tuberculous peritonitis;* in *glaucoma;* in *interstitial nephritis;* and in disorders associated with oversecretion, such as *coryza, hay-fever,* and *eczema.*

In ordering a salt-free diet it is obviously necessary to know the amount of sodium chlorid represented in the various food-stuffs, and to be able to control the manner in which it is cooked.

The strict *salt-free diet* commonly ordered consists of the following articles:

Bread baked without salt and eaten with fresh, salt-free butter or clotted cream. Rice, barley, tapioca, or sago, well cooked and eaten with cream and sugar or molasses, mashed potatoes without salt, eaten with fresh butter, eggs, two to four per diem, usually soft-boiled and eaten without salt. A small amount of certain fruits, orange, grape-fruit, or grapes, is allowed daily.

Not more than one pint of liquids is taken daily—generally milk diluted with Vichy or lime-water.

The quantities are prescribed to suit the case. Where a more liberal diet is permissible, as in chronic cardiac affections, meats cooked without salt, fresh-water fish, vegetables, salads, and fruits, both raw and cooked, all without salt, are added, with salt-free cheese and simple desserts. The food must be given in its most digestible form, since in omitting salt we omit one of the aids to digestion.

Oxaluria (calcium oxalate in the urine) is a symptom associated with gout, certain forms of rheumatism, and many nervous disorders. Acid fruits and vegetables aggravate the condition. The diet excludes tomatoes, rhubarb, plums, and all berries, either raw or cooked; spinach, cauliflower, green beans, and potatoes; cocoa

and chocolate. Tea, coffee, and alcohol are either forbidden or their use strictly limited. The food must be simply cooked, avoiding rich dishes, spices, and seasonings.

Diabetes Mellitus.—No disease depends for its treatment so entirely on diet as diabetes, which is characterized by the persistent presence of grape-sugar (dextrose, one of the glucoses) in the urine, and the passing of large quantities of urine of a high specific gravity.

No condition has been more benefited by the advance in scientific knowledge of food values, and by the application of such knowledge to special dieting.

The treatment known as *Dr. Allen's starvation diet*, introduced in quite recent years, may be said to have revolutionized the treatment of diabetic cases. Under this treatment a patient is kept "sugar free," thus preventing the serious waste which is the chief symptom of the disease; he is given a varied diet, suited to his individual needs, and based upon his individual tolerance for carbohydrate and protein, and also one in which the amount of food taken, reckoned in calories, is in direct relationship to the energy he expends. The main points brought out in the treatment are:

1. Diabetic patients can be starved without risk of coma or other ill effects; that during starvation the sugar excreted rapidly diminishes and shortly disappears.

2. Protein in excess also produces glycosuria; it is, therefore, as important to control the protein intake as the carbohydrate intake.

3. It is possible by careful dieting and regulation of the activities of the individual to keep a patient "sugar free" on a mixed diet.

To describe the dietetic treatment briefly: The treatment begins with a period of starvation, averaging forty-eight hours, at the end of which the tested urine specimen shows no sugar. During the starvation period the patient remains in bed and is given water freely and clear meat broth, tea, or coffee without milk or sugar. A little weight is lost during the time, but where the patient is obese this is considered an advantage. In severe cases the patient is prepared for starvation by reducing his diet first over a

period of several days; in others starvation periods alternate with one or more days of restricted feeding. Once the urine is sugar free, a carefully graduated diet is begun, introducing first carbohydrate, then protein, then fat into the diet, until the patient reaches a mixed diet from which he can derive the necessary amount of *calories*.

The different food elements are introduced in minimum quantities, increased very slowly so as to test the patient's tolerance accurately, the carbohydrate and protein foods being added to at first on alternate days. Every article of food given must be strictly weighed or measured, its chemical composition clearly understood, and its caloric value estimated.

Such a diet is, of course, always undertaken by a doctor's orders and under supervision. The urine is examined daily, the patient's weight noted, and his exercise regulated, so that he may not use up more energy than he is taking in according to the caloric value of his food.

After the urine has been sugar free for twenty-four hours the diet scale is begun.

Carbohydrate is the first food element given. The first day after starvation the patient is given 150 grams of vegetables which contain only 5 per cent. carbohydrate. Roughly speaking, these are all the green vegetables (except peas, lima beans, and shell beans). After cooking the available carbohydrate is reduced about one-half. If the vegetables are boiled in three different waters (kept at boiling-point), rather more than 4 per cent. carbohydrate is lost. By this means patients may be given bulk with a minimum amount of carbohydrate. In many hospitals thrice boiled 5 per cent. vegetables is the first food ordered after the starvation period. A little butter is often allowed with them.

The second day 10 per cent. vegetables are added to the 5 per cent., sufficient to add 5 grams carbohydrate. Roughly speaking, 10 per cent. vegetables include the ground vegetables, except artichokes and parsnips which contain 15 per cent. carbohydrate, and potatoes which have 20 per cent. After the first day 5 grams carbohydrate is added daily up to 20 grams, and then 5 grams on alter-

nate days until sugar appears or the tolerance reaches 3 grams C. per kilogram of the body weight. The carbohydrate foods are taken successively up from the 5, 10, and 15 per cent. vegetables and 5 and 10 per cent. fruits to potato, oatmeal, and bread.

Protein.—When the patient has been sugar free for two days, protein is introduced usually in the form of three eggs, representing 20 grams protein (approximately, as eggs differ in weight). On the following days 15 grams protein are added daily in the form of lean meat until the patient is getting 1 gram protein for each kilogram of his body weight.

Fat is added when the protein taken reaches 1 gram per kilogram weight, and added at the rate of 25 grams daily until the patient is taking not more than 40 calories per kilogram weight. Fat is taken in the form of butter, cream, milk, fat of meat, etc.

If sugar reappears the patient again fasts until sugar free; the diet scale is then begun again, but increased twice as rapidly as in the initial test. Only half the amount of carbohydrate tolerated is given till the urine has been sugar free two weeks, and it is then increased not more than 5 grams a week.

The above test-scale, taken by permission from the instructions issued to the patients in Dr. E. P. Joslin's diabetic clinic, the Deaconesses' Hospital, Boston, varies in some respects in different hospitals and with individual practitioners. The tendency of the present day is to reserve the initial strict starvation for acute cases.

Patients under a strict diabetic régime are usually required to fast once a week. Where the carbohydrate tolerance is low, a complete fast is required like the initial fast; where the tolerance is greater, it is modified accordingly. It is important that the urine should be examined once a week, and this patients can be taught to do for themselves, using Benedict's test (p. 242). Patients should also be taught to select their own diet, computing the amount of calories of carbohydrate, protein, and fat represented. A short table of the permitted foods with their chemical composition and caloric value is usually issued

to hospital patients, and they are given practice under supervision in computing their diets. In this way a patient is made self-reliant and can be trusted intelligently to carry on his own treatment. A set of very comprehensive diabetic diet charts compiled by Dr. Mosenthal of Johns Hopkins Hospital are on the market, published by Paul B. Hoche, 67–69 S. 59th Street, New York. The charts are widely used at the present day in private practice, and will be found by nurses a very great help in computing varied diets while following a strict diabetic régime. The charts comprise: 1, starch-free diet; 2, accessory diet for foods rich in carbohydrates; 3, minimal fat starch-free diet (measured); 4, ditto (weighed); 5, low fat starch-free diet (measured); 6, ditto (weighed).

By careful tests with the calorimeter (p. 734), the amount of energy the patient may expend in proportion to the calories he is able to take in is ascertained, and the habits, avocations, and exercise regulated accordingly. A patient "at rest" is considered to require 25 calories for each kilogram of his body weight. This provides no surplus energy for work or exercise; where a larger proportion of calories is *tolerated*, *i. e.*, can be assimilated without producing glycosuria, the amount of exercise taken, or work permitted, is regulated accordingly.

No food is prohibited provided the patient can tolerate it and that it can fit into the required proportion of his diet. Oatmeal and white bread are exceptionally high in carbohydrate and can only be taken where the carbohydrate tolerance is high, and then only in small quantities, which reduces the bulk of the food-stuffs.

Patent flours are on the market with a very low carbohydrate percentage from which rolls and muffins can be made. Such are Lyster flour, Hepso flour, and others. A Lyster roll contains C. 0.23 grams; P. 71.5 grams; F. 5.87 grams, and represents 83.20 calories. As the diabetic tolerance of carbohydrate is lower than normal the necessary calories are made up by *fats*, which produce the same *kind of energy* in the human economy as the carbohydrates, and give, as we saw in Chapter XXI, bulk for bulk, approximately twice the number of calories. Where the

appetite is large the diet can be made to include foods which give a large amount of bulk in proportion to the caloric value, as in the green vegetables; where the appetite is small the reverse will be indicated.

Acidosis, a disorder characterized by decreased alkalinity of the blood and the presence of acetone and diacetic acid in the urine (test, see p. 244), is a condition at present receiving much consideration, though, so far, imperfectly understood. The acute attack is a severe form of intoxication and the patient will be invariably in the doctor's hands. Children with a disposition toward acidosis must have their diet carefully regulated, and nurses should understand the principles underlying the selection of such a diet.

The condition is considered to be due to an impairment in the metabolism of fat in the body, due most frequently to some form of starvation for which there may be a variety of causes.

A carefully regulated diet is the chief prophylaxis in keeping a child disposed to acidosis free from an attack. The dangerous food elements are the fats and the foods in which the acid-forming elements predominate. The aim in dieting must be to contrive a well-balanced diet that will be well borne by the patient, and this can only be arrived at by testing the individual tolerance. Fats (butter, cream or whole milk, and fat of meat) are eliminated entirely during an attack, however slight, but as fats are necessary to the growth of the body they must on recovery be very gradually added, the child's tolerance being tested day by day. Meat, eggs, and certain cereals, oatmeal, rice, wheat and corn, rhubarb, strawberries, and all sour fruits are foods in which the acid-forming elements are in excess; their use must be guided by individual tolerance. Vegetables, especially potatoes, turnips, peas, and beans, and cooked fruits, such as prunes and apples, are foods in which the building-up elements predominate and should form a staple part of all such diets. With the exception of the cereals mentioned the diet is largely carbohydrate and can without much difficulty be made appetizing to most children. With the

above facts in mind a varied and sufficient diet can readily be computed.

Phthisis.—At the present day most people realize that a prominent part of the treatment of all forms of tuberculosis consists in a well-balanced dietary of easily digested foods. A larger amount of food than is necessary in the normal condition is required to increase the resistance of the body to the disease and to repair the tissue waste. A well-mixed diet of a somewhat raised caloric value is usually prescribed. To avoid indigestion, this is given in easily digested and concentrated forms. The most valuable articles in a consumptive's diet are milk, cream, and eggs. Milk is taken between the meals, and with the lighter meal —either breakfast or supper; eggs, as a rule, are taken raw. In this way they are not actually so easily digested as when lightly boiled, but as the patient tires less easily of them, more can be taken over a greater length of time. From 8 to 18 are often consumed daily without causing indigestion. Fats and oils are also of value, and in the phthisis dietary largely replace carbohydrates. They are more highly concentrated, have, bulk for bulk, twice the caloric value, and, further, they help to correct the constipation that commonly results from any large consumption of milk and eggs. Fats are given in the form of cream, bacon-fat, olive oil, and the fat of various meats.

Scurvy.—Scurvy is directly due to a deficiency of certain food substances, notably the vegetable acids and the vitamins referred to in the previous chapter, and results from a diet in which milk, fresh meat, vegetables, and fruit have not been included.

In adults, fresh meat, vegetables, milk, and the juice of oranges and lemons are ordered. When sailors have to be long away from supplies of fresh food, lemon-juice, onions, and vinegar are taken as preventives.

In infants, scurvy is most frequently the result of using sterilized milk, condensed milk, or some of the proprietary infant's foods. A diet of fresh milk, beef-juice (1 dram to 1 ounce daily), and orange-juice (1 ounce to 4 ounces daily) is usually sufficient to correct the condition. Beef-

juice is not given until after the tenth month, and is contraindicated if the intestines are in an irritated condition.

Rickets.—Rickets is a disease of young life, the result of a deficiency of lime salts, in consequence of which the bones become soft and deformed. It is generally caused by a diet containing too little protein and fat and too large a proportion of carbohydrates, as is frequently the fault in proprietary foods.

A liberal diet, including fresh milk, egg-albumen, and beef-juice, broths, or fresh meat, if the child is old enough, is necessary. At the same time fresh air and good hygiene are equally important. Fat in the form of cream, butter, and bacon-fat should be given. Cod-liver oil is often ordered, and usually some preparation of the phosphates, such as the syrup of the hypophosphites (5 to 15 minims).

In **anemia** the quality and composition of the blood is altered, and there is a marked deficiency of the red coloring-matter or hemoglobin and of the red cells.

The diet must be liberal, nourishing, and digestible. It should include concentrated nourishing foods, especially eggs, beef-juice, or, if the digestion permits, rare tender beef-steak and other meats; milk, cream, butter, bacon-fat, and well-cooked cereals. Nourishing soups are also given, and vegetables, especially green vegetables, on account of their mineral salts. Spinach, which contains iron, is particularly suitable.

Anemic girls have often very capricious appetites and abnormal cravings for such articles as chalk, earth, etc. Others enlist sympathy by pretending to be unable to eat, and satisfy their appetites in secret. In these cases the patient may require close watching, and the right diet may have to be forced.

CHAPTER XXIV

THE HEAD NURSE AND WARD MANAGEMENT

Division of Duties—Orderly—Ward-maid—Time-table—Reporting—Stock-book and Inventories—Linen Supply—Blankets—Patients' Effects—Special Duties of a Head Nurse—Patients' Visitors—Domestic Work: Sweeping, Mopping, Scrubbing, Polishing, Dusting, Care of Enamelware, Glass, Porcelain, Marble, Polished Furniture, Stains on Wood, Saucepans and Kitchenware, Ice-chest, Brass and Copper—Beds and Bedding—Ward Ventilation and Temperature—The Visiting Rounds.

An essential quality of a successful head nurse is executive ability. While in a well-organized hospital the lines are already set in which the work must run, most days will bring fresh circumstances which alter conditions so materially that, unless rules and orders are promptly adapted to meet them, confusion, rushed work, and overwork of the most willing are the result.

On her shoulders falls the responsibility of carrying on the daily work adequately and without friction; of administering the domestic side of ward work; of insuring the proper fulfilment of all orders for treatment; of preserving the equipment, instruments, etc., in her charge in good condition; of keeping up supplies and preventing waste in their use; of the physical and mental well-being of the patients under her care. At the present day she is not often held responsible for the actual instruction of the pupil nurses, but, as a matter of practical experience, we know no teaching impresses itself more forcefully on the pupil than that gleaned from the practice and example of a ward head nurse, from her manner and attitude toward patients, workers, doctors, and visitors to the standards of work required by her from each pupil working under her. "As the twig is bent so the tree is inclined"; a nurse's work will carry through life something of the impress of the first wards in which she practised her duties,

In the present chapter we should like briefly to suggest, from our personal experience, some methods in which the practical work of a head nurse can be so ordered as to be both simplified for herself and of wide-reaching use and comfort to others.

DIVISION OF LABOR

From the early days of her training the pupil nurse should be given some responsibility, and that one duty, however small, be used as a training-ground in thoroughness, punctuality, and in observation, as well as in the acquiring of a sense of responsibility, without which she will never be a reliable worker.

In arranging a schedule of work among several nurses the duties are graded according to the progress of the individual training, the more responsible forms of treatment being given to the senior, and the simplest duties to the newest comers. At the same time many duties should be common to all, and others of monotonous routine may, with advantage, be interchangeable from week to week. It is no uncommon thing, where nurses are left to divide their own minor duties, to find the youngest worker passing her entire time in an accumulation of monotonous and profitless routine duties, tiring to body and spirit, while the senior nurse performs not the smallest minor duty and usually ends by considering such duties beneath her dignity.

While the nursing of the patient is the most important part of our work, to make such distinctions in any necessary duty connected with the care of the sick shows a lack of common sense and results in harm. Is it not the first step toward that attitude that makes people say, too often justly, " A nurse wants so much waiting upon."

No definite lines can be laid down as to the division of work, since it must depend on the amount of the work, the kind of the work, whether medical, surgical, children's, or special nursing, whether in a general ward or private rooms, and must always be modified by the hospital construction or the number of workers. A suggested outline may, however, be helpful.

In some wards each nurse is given a certain number of

"beds," and the absolute charge of those patients, making their beds, attending to all their wants, giving them their meals, their medicines, and carrying out all their treatment.

When the patients are in single rooms, as with private patients, this is almost necessary, and in children's nursing the system also works well, as all children, whether very sick or convalescent, require a great deal of individual care and attention.

In general ward work the patients should be so divided, to a certain extent, that is to say, for their bed-making, washing, and routine treatment (such as douching, etc.), to avoid the discomfort for the patient of constant change; at the same time, in an open ward, all the nurses are familiar, and for one nurse to take his temperature and another to give his medicine or his food does not mean for a ward patient a perpetual fresh face, as it would for one in a private room.

When possible, the patients in a nurse's immediate charge should be grouped together, in order to save her steps, and that she may readily be within call of each; she should then be held responsible for the neatness and cleanliness of that particular division of the ward, with the lockers, bed-tables, and personal effects of her patients. Where the cases are acute, a smaller number should be given to a nurse than where the cases are mild or convalescent.

It is usually a mistake to give a junior nurse only convalescent cases. If she is in earnest over her work, a few weeks will teach a nurse the actual handling of a sick patient, and such responsibility as observation of symptoms or the carrying out of more difficult treatment is always, in ward work, shared by those over her. Nothing will deepen the sense of responsibility, quicken the powers of observation, resource, and helpfulness, or put an end to a frivolous or flippant attitude toward the work like contact with acute illness early in the training.

If, however, the duties are otherwise arranged, a point must be made that the junior nurses help the seniors with the acute cases.

Dusting and Cleaning.—The daily dusting and cleaning of a ward ought certainly to be divided between all the nurses,

for the reason already stated. Usually the work can be grouped, as, for example, one side of the ward with certain tables, dressing-stands, etc.; the other side, with bath-room, corridor, or equivalent; the service-room and lavatories, and so forth, according to the hospital construction. It matters little how, if the adjustment is fair, and if each nurse knows exactly what her own work is. In this respect the senior nurse's duties may be lighter than the others, since she will probably have certain other duties which cannot be shared.

In the same way the closets, drawers, and supply-boxes should also be divided between the nurses, and each held responsible for keeping her share in perfect order and fully supplied. Thus the medicine cupboard would be in charge of one, the surgical supply closet of another, the clothes-closet, linen-closet, milk-chest, refrigerator, and china closet all divided out. Besides the daily care, it should be a rule that each closet, etc., be thoroughly cleaned, over-looked, and the supplies brought up-to-date once a week regularly. If such work is left merely to the convenient moment, it is never done.

Duties that may be interchangeable are, for example, the giving of the regular medicines; the preparing and distributing of lunches and extra nourishment; minor dressings, fomentations and poultices; the taking of the regular temperatures; the counting of soiled clothes for the laundry, and distribution of daily clean towels, etc. These duties may often, with advantage, be taken by the nurses in turn for a week at a time, a regular order of rotation being maintained. There must, however, never be any doubt as to who is responsible for each duty.

A rule that admits of no exception should be that each nurse cleans whatever she herself has used, and returns it to its place as soon as it is done with. The habit of making younger nurses fetch and carry and clean up for the older ones may be good discipline for the junior, but is altogether wrong from any other point of view. If any one requires special help, it is the less experienced junior.

The **night nurse,** although exempt from the work of meals and the busy rush of the doctor's visits, still, if the

patients are sick, has her hands too full to give much time to the domestic ward work, nor can she be given duties that keep her out of the wards, even in the diet kitchen or service-room. There are periods, however, especially in surgical wards, where there may be a considerable amount of idle time while the patients sleep. It is always best to leave definite work for these hours, otherwise novels, letters, or fancy work will creep in and open the way for wasting time that belongs to the patient.

If the hours on duty of the night nurse overlap those of the day nurse, it is usual to give some special duties for this time, since she is no longer wanted exclusively in the wards, such, for example, as counting out the laundry, cleansing and disinfecting the lavatory crockery. With more common-sensible ideas, however, on the uselessness of unnecessarily prolonging hours of duty, the hours of a night nurse are generally curtailed as much as possible.

THE ORDERLY

In a male ward the orderly has very definite duties. He gives the baths to all except the very sick, attends to bed-pans and urinals, enemas, and similar treatment, assists the doctors with the screen cases, and helps in other minor duties, such as feeding helpless cases, and so forth. Usually the domestic work given to him is the care of the lavatory crockery, including the spittoons, and the polishing of the ward "brights," such as taps, gas-brackets, etc. Where his duties are light, some general cleaning is often given, too—window cleaning, for example, or cleaning walls. When it can be avoided, however, the orderlies will generally be found to give more satisfactory work if they are kept to duties that immediately concern the patients.

THE WARD-MAID

Next to a good head nurse, a good ward-maid is probably the most important item for the general comfort of a ward. Her duties vary considerably in different hospitals. In some she is merely the scrubber, occupied entirely with floors, grates, where such exist, and washing up dishes; in others, besides these duties, she sets the trays for meals,

helps in serving them, and does a fair share of the ward dusting and cleaning. I think most experienced nurses will agree it is a mistake to have her do even minor duties about the patients. Whatever her duties, they should be well defined, and the daily duties performed always in the same order, and as nearly as possible at the same time, the weekly cleaning in a certain order of rotation.

It is a good system to have the ward-maids' duties written down and hung where they can be readily referred to. At the same time, it is better to avoid needless details or a schedule written out with fresh duties opposite every half-hour. You will find these long and minute schedules are never read and rarely referred to. A schedule prepared in the following order is generally practical:

Ward-maid—Ward A.

Hours of meals:	Breakfast ...	
	Dinner ...	
	Supper ...	
Hours of duty:	Morning ...	to ...
	Evening ...	to ...
Hours of patients meals:	Breakfast ...	
	Dinner ...	
	Supper ...	

Daily Work.

Before breakfast:	Set breakfast trays; prepare and help to serve patients' breakfast.
After breakfast, until some specified hour:	Wash breakfast things, sweep wards, scrub lavatories, clean kitchen, ice-box, etc. (including the routine work in the order in which it is most conveniently performed).
A specified hour:	Begin weekly cleaning.
A specified hour:	Set patients' dinner trays, etc. (enumerate the special duties entailed).
After dinner:	Wash patients' dinner things. Tidy kitchen, etc. Finish the weekly cleaning before the time off duty.
Before supper:	Set patients' supper trays, etc.
After supper:	Wash patients' supper things. Tidy the kitchen, etc.

Weekly Cleaning.

Monday:	Scrub	Thursday:	Scrub ... ...
Tuesday:	Scrub	Friday:	Scrub ... ...
Wednesday:	Clean closets, etc. Turn out china closet.	Saturday:	Sweep walls. Clean knives and spoons, etc.

It is human nature to work better if we feel a certain responsibility and possession in our work, and it is time well spent to stimulate this feeling in our ward-maid. Give her also some one thing in which she can take a special pride; for example, give her the charge of the china-closet, and take time yourself to go over a working inventory of its contents with her on specified dates. You will hardly find one who will not respond to this treatment, and do all her work better for the little personal notice this entails.

HOURS OFF DUTY

The length of the hours on duty is not determined by the ward head nurse, but with her usually rests the arrangement of the hours of the specified time off duty. In the hands of a good organizer the practice acts well, but we have all realized its shortcomings in the hands of a woman incapable of looking forward beyond the immediate needs of the hour.

In hospitals for private patients, where the doctors change constantly and their visiting hours with them, and in similar conditions, the nurse's time-table may require readjusting daily, but there seems to the writer little excuse in the general wards of general hospitals for not preparing a schedule of time off duty that will be practical at least from week to week. We are never tired preaching to our pupils the uses of recreation and the value of keeping up their outside interests, but we make it very difficult for them to do so if they can make no engagement even a day ahead, and feel secure they can keep it.

As a matter of fact, we can foresee the work much more than we think. Certain events, such as the meals and all the details of routine work, occur at the same hour every day. In a medical ward there are certain hours in which the pressure of work will be greatest, such as the hours in which temperature, baths, packs, or sponges are prescribed, and other quieter hours, in which the work usually will not be beyond the attainments of a junior nurse, while, especially in a teaching school, the hour at which the visiting doctor arrives with his students is generally known and fixed. In a surgical ward the hours for dressings, the sur-

geon's visit, even the operating days and hours, are practically unchanged year in and year out. Is it not, then, quite practical to decide at what hour, you are most likely to be sure to require your senior nurse or to be able to manage with the juniors? To know definitely when she is to be " off " and when " on " is a real source of contentment and pleasure to a pupil, and should not be denied merely for want of the will to take some pains in the matter and look sufficiently far ahead. The hours may then be printed or written up in some convenient place for ready reference, thus:

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Senior.........						
Second nurse...						
Third nurse....						
Probationer, etc.						

with some simply worded notice that sudden emergencies and other special conditions may call for a temporary re-arrangement of the hours. The Sunday hours are usually arranged specially, that each nurse may have a larger portion of the day to herself and sufficient time to attend her own church. The specified hours may be taken in rotation, so that each may know beforehand what time she can count upon.

Punctuality, both in leaving the wards and in returning to duty, should be exacted. At the same time our patients are considerably more than our mere duty, and any service begun for a patient should, as a rule, be finished by the same nurse, to avoid the changes so trying to the average patient. The habit of consideration for the patient's feelings cannot be too strongly insisted upon as the most important point of view, in spite of conflicting interests.

REPORTING

As a matter of routine, every nurse on going off duty or on returning should report verbally to her head nurse or to the nurse taking the head nurse's place. This habit

keeps the head nurse in touch with the individual worker, gives an opportunity for communicating facts, orders, etc., which might otherwise be overlooked, and insures punctuality.

At the same time, every detail in the treatment of a patient should be written down in a form that can be readily available for quick reference. The system of reporting can be so complicated as greatly to increase the day's labor; the aim should be to supply accurate information in the simplest manner possible.

Report Book.—A system of report books, one for day duty and one for night, arranged after the following example, has been found practical and convenient:

Example: John Jones.

Temperature, pulse, respiration	8—12—4—8
Milk, 5 ounces; Vichy, 2 ounces......	10— 1—4—7
Water, 5 ounces	9—12—3—6
Medicine	10—2—6
Whisky, 2 drams	9—12—3—6
Sponge at 70° F. for twenty minutes for temperature over 102.4° F.	8—12—4—8

Where the card system for giving medicine is used (p. 315), it will not be necessary to write down the medicine.

As each detail of the treatment is carried out a pencil mark is crossed through the hour. At a glance, then, the nurse in charge can ascertain what treatment has been done and what omitted. If purposely omitted as not necessary, or for some other reason, a circle may be drawn round the hour or some similar distinctive mark made.

For example:

Sponge at 102.4° F., etc. ~~8~~ ~~12~~ 4 ~~8~~

A mark without either cross or circle would indicate that the treatment had been forgotten.

Such a book is both order and report book. Its disadvantage lies in the considerable amount of writing entailed morning and evening. This may be mitigated by using copy-books with the sheet a convenient size to be ruled off into several spaces, each representing a day. Where no changes in the orders have been made, the space will merely indicate " as before," the hours alone requiring

to be written again. The writing of the orders should be the duty of the head nurse.

The **doctor's orders,** from which the above reports are compiled, should, without any exception, be in writing, and no change in treatment should be permitted except on receipt of a written order. The doctor's orders, including diet, direction for treatment, and medical prescriptions, are in some hospitals entered directly in a ward day-book; in others, on bed-boards or prescription sheets hung over the patient's bed, side by side with his temperature chart and his history notes. Either practice has its advantages and some drawbacks. It may, for example, frequently be a disadvantage for a patient or his friends to have such easy access to all information concerning his treatment. If the bed-board system is used, it is a rule that, as soon as an order is written, the board is laid on the table until the order has been entered in the " report " book.

The **temperatures, pulse,** and **respirations,** together with the record of the excreta, are entered in a separate copy-book from which the temperature charts are compiled. Unusual symptoms, such as rigors, vomiting, etc., must obviously be reported instantly to the head nurse, and by her to the doctor, but as a further safeguard against oversight the fact and the hour of occurrence should be noted on a slip of paper and placed on a file on the record table.

The **night report** should be reinforced by a written summary from the night nurse with reference to the sleep, special symptoms, fresh orders, and treatment of the patients under her charge during the night.

Verbal reports are also important, especially as a training to the pupils for their future work. It is not really an easy thing for the average nurse to collect her thoughts at a moment's notice and remember all necessary facts about an individual patient, or many patients, and few without practice have the faculty of stating the facts accurately and briefly without the help of leading questions. And yet, either as head nurses or in private work, such reporting is constantly required of them. The pupils should be taught a certain routine form, beginning with routine facts,

such as temperature, record of excreta, sleep, appetite, etc., and finish with abnormal symptoms. As a rule, such a report should be received from each day nurse before finally leaving the ward for the night, and from the night nurse when she has finished her work in the morning. After receiving the night nurse's report and reading the order book, etc., the head nurse should call the day nurses together and go briefly over the changes in the order of treatment and the report of special symptoms, etc., that have occurred during the night.

It may be pertinent to add that there is often a tendency to allow reporting to degenerate into gossiping or chatter on irrelevant subjects. Young head nurses in particular should be careful to guard against such a habit. Insist always that all reports are given in a business-like attitude, and in concise, business-like terms, the reporting nurse standing upright, her hands crossed in front of her, in an attitude of drill. Nurses giving their reports either lolling over the table or standing, their hands easily on their hips, is not a matter that actually affects the well-being of the patient, but certainly suggests a lack of finish in the training that will probably also have other more important manifestations.

Charts.—From the above "reports" the daily records are compiled in the form of *charts*, some of which form a permanent part of the patient's history, and all of which are preserved for reference during the whole course of the patient's illness (Chap. V).

A special sheet should also be kept recording the diet of each patient, for quick reference at the serving of meals.

Diet-sheets.—In all hospitals the different diets are classified under such headings as liquid diet, house diet, extra diet, etc. (p. 770). A printed table is generally kept, with a list of the items included under such headings. Extras are ordered by item, such as oysters, fruit, game, beef-juice, extra eggs, or milk, etc.

The diet-sheets should give the names of the patients under the different diets, and be corrected from day to day.

STOCK-BOOKS AND INVENTORIES

Stock-books.—The care of the equipment is again one of the important responsibilities of a head nurse. Left entirely to such casual care as the individual worker may think of bestowing, we have invariably, as the result, a spectacle of loss, waste, and destruction of property that positively seems wanton, and accounts, year by year, for considerable sums of money that would otherwise be available for other purposes. To guard against such a condition, a system of methodical and scrupulously honest stock-keeping, coupled with persevering and constant vigilance, is necessary. The former should not be left to the initiative of young head nurses. A good and simple system should be thought out by the hospital authorities, and carried on in every department with similar care, whether wards, operating-rooms, laundry, kitchens, library, or any other department.

Every article given to a ward (since we are at present discussing ward work), from the weekly allowance of soap or safety-pins to bed-linen, surgical instruments, or new furniture, should be entered in writing. This may be done elaborately by a system of card cataloging, always in the long run a convenience, or more simply by keeping a set of requisition books and checking carefully the articles received. For example, one book would be reserved for household supplies, another for ward crockery, a third for linen and ward furnishing, and a fourth for surgical instruments and supplies. These books are thus in the nature of receipts, and should, therefore, not be destroyed when complete until a given time has elapsed.

This, however, constitutes but the first step in the necessary care. The next is to minimize the risk of loss. The best way yet devised is to take regular, and, one may add, *honest*, inventories. How often the inventories should be taken may be a matter of opinion, obviously, the more frequently they are done, the more easily will they be accomplished.

Inventories.—The inventory for the *ward china, glass, knives, and spoons*, etc., may be conveniently kept in the form of a sheet or card ruled into weeks and fastened up

inside the china-closet. The complete number of articles in stock should be entered at the beginning of the list, and a regular day set aside for the counting. It is a good rule to do the counting each week on the day on which the china-closet is scrubbed, and an excellent plan to do it with the ward-maid. She soon comes to feel responsible for not allowing the articles to stray, and after a few weeks of encouragement on the subject will invariably take a pride in keeping her things together.

FORM OF INVENTORY

	February.			
	7	14	21	28
30 cups	30			
30 saucers	30			
60 plates	60			
30 glasses	30			
60 spoons	60			
30 knives	30			
30 forks, etc.	30			

The same form of inventory may ke kept for *surgical instruments* and supplies, for lavatory supplies, including bed-pans, urinals, sputum-cups, rectal tubes, catheters, douche-cans, etc., and for medical supplies, including pneumonia jackets, stupe flannels, poultice binders, and so forth. These inventories are usually most conveniently kept in small separate copy-books. They also should be taken at regular and frequent intervals—once a week is not too often—and gone over personally with the nurse in whose charge they for the time are. When these duties are changed, the inventory should be again carefully checked, that the nurse taking up the duty may know exactly what she is responsible for.

The *furniture inventory* (beds, mattresses, lockers, etc.) is frequently not left in the charge of the head nurse, but kept and taken from time to time by the hospital authorities.

The *linen inventory* is perhaps the most important of all, since, of all ward equipment, this alone leaves the ward

and is handled, both for washing and for repair, by persons outside the ward. As the linen represents a very large item of expenditure, it should be closely looked after. Besides the regular inventory, the care of the linen entails a carefully kept laundry book and a repair book.

Printed *laundry books* with duplicate slips which are sent to the laundry with the soiled clothes are usually provided. From the duplicate slips the clothes can be rechecked in the laundry, and by comparing the return laundry with the list in the book, losses can, to some extent, be at once detected. Where the laundry sorting-room is well organized, linen for repair is usually sent straight from the sorting-room to the linen-room; in other cases it should be a special duty of one or other of the nurses to sort out the clean linen and set on one side all that require repair. In either case the articles should be enumerated in a book kept for the purpose, which may conveniently be arranged as follows:

Example:

Items.	*Received.*	*Returned.*	*Condemned.*
3 sheets	March 8th	2, March 12th	1

All condemned articles are replaced by new ones either immediately or, more conveniently, on a certain day, say, once a month, thus keeping up the full supply of linen.

The linen inventories have a more official appearance, and are generally more carefully kept, if printed forms are used in place of the ruled copy-books, which are quite sufficient for china lists and surgical supplies, etc. They can be bound inexpensively in the form of small books. The first page should state the standard number of the different articles required. Some losses are almost certain to take place from month to month, at least until the inventory system is well established, and the full amount will from time to time, perhaps twice a year, require to be made up.

A practical linen inventory may be arranged in the following manner:

.... Ward. No. of Beds........
Date...............

Number preceding month.	*Items.*	*Condemned.*	*New.*	*Unaccounted for.*	*Total.*	*Number per bed.*

Signed .... Head Nurse.

New articles are given only in place of those condemned. "Unaccounted for" may indicate actual loss or merely that the articles have strayed to another department, to be recovered subsequently. One of the most satisfactory results in keeping careful inventories is observed in the steady decrease in the numbers under this heading as the practice of taking the inventory becomes confirmed. By placing on the left of the list the number of the preceding month (or last inventory), and not the standard numbers, the date of any loss is clearly shown.

The amount of linen required by a ward depends on the activity of its service and its laundry facilities. Thus, if the linen sent down daily is returned on the following day, a smaller amount will be necessary than if the linen is returned from the laundry only twice a week. The following list includes the average amount per bed usually considered necessary:

Sheets	6 to 10 per bed.
Draw-sheets	4 to 6 " "
Pillow-cases	6 to 10 " "
Blankets	2 to 3 " "
Spreads	$1\frac{1}{2}$ to 2 " "
Patients' towels	4 to 6 " "
Diet towels	4 to 6 " "
Roller towels	12 to 24
Hand towels for doctors	36 to 72
Dish-towels, and all other small towels, etc., of each	6 to 12

If night-shirts are provided, the supply can hardly be too generous; in many hospitals, however, the patients supply their own shirts, a certain number especially made for bed cases only being supplied by the hospital.

CARE OF LINEN

The care of the linen is, however, only begun with the taking of the inventory, and a head nurse will find herself obliged to exercise constant vigilance in its use.

Insist, in the first place, that linen is used only for the purpose for which each piece is provided, otherwise pillow-cases will serve for sand-bag covers, crumpled sheets for draw-sheets, and all small towels for dusters, all of which implies an increase of wear and tear on an unnecessarily good class of material. Stains which result from carelessness or inevitably from the kind of work should be treated as soon as they occur, and before, if possible, they have time to dry.

Blood-stains should be soaked in cold water, and not allowed to dry before they are washed. They should be washed with Ivory soap in cold water. Small stains on mattresses or pillow-ticking can be completely effaced with peroxid of hydrogen. This, however, is an expensive method, only permissible where it is impractical to wash the articles in question.

Sheets and diapers soiled with fecal matter should be taken at once to the lavatory hopper and under running *cold* water brushed as clean as possible with a long-handled hard brush. The custom of sending badly soiled sheets or infants' diapers to the laundry without such treatment, to wait possibly twenty-four hours before they are washed, is obviously objectionable, and especially so in hospital work.

Ink-stains should not be exposed to light or treated with hot water, since either will blacken the nitrate of silver all inks contain.

In the Boston Cooking School Cook-book Miss Farmer recommends washing in a solution of hydrochloric acid, rinsing immediately after in ammonia water (to arrest

the action of the acid); the stain is then wet with warm water, rubbed over with Sapolio, and gently rubbed between the hands. Small spots may be covered with salt and rubbed with a piece of lemon.

Stains from **iron-rust** are still more difficult to remove, but may yield to the same treatment as that for ink-stains. Whenever an acid is used in bleaching, the material must be rinsed in an alkali to check the action of the acid, which will otherwise cause holes.

Iodin stains when fresh may be removed by washing; old stains are treated with a paste of starch and alcohol, or, if trifling, by sponging with ammonia-water or with alcohol.

Tea and **coffee stains** are easily removed if washed at once; if there is milk or cream in the stain, it must first be washed in cold water.

Fruit-stains, especially those from peaches and pears, are very intractable and are indelible if the linen is washed before removal. Hydrochloric acid or oxalic acid may be used exactly on the spot, rinsing immediately in ammonia water, and then washing with Ivory soap and cold water.

Stains from oil or grease must also be removed before the linen is washed. Ether, benzin, or gasoline may be used. As these are highly inflammable, care must be taken to keep them away from an exposed light. When the stain is small, Ivory soap and *cold* water may be sufficient to remove it.

Bichlorid of mercury turns linen an ugly gray color after it is exposed to the heat of washing, and should, therefore, not be used for disinfection. If stains occur, they may be removed by soaking the linen in a cold solution of chlorinated lime and carbonate of soda (Labarraque's) for several hours. They must then be at once rinsed and washed, as the soda is injurious to the linen.

Linen torn in any way or wanting tapes or buttons should be set aside for repair, and not, as is too often the case, used again and again until a small tear has become one wanting several hours' work.

Disinfection of Linen.—See Disinfectants, Chap. XII.

BLANKETS

The most careful washing in time causes blankets to shrink and invariably spoils their appearance. With the more expensive varieties, such as provided for the private rooms, it is an economy, in the long run, to send them to the dry cleaners rather than wash them. From the dry cleaner they return as good as new, and with reasonable care will last many years. Nurses should take a pride in keeping their blankets clean. Finger-marks and spots can be minimized by doubling the end of the spread over the tops of the blankets before turning back the sheet. If stains occur, they should be sponged aff at once in cold water, after which place the portion to be washed over a board, and with a piece of flannel wash off the spot with a lather of Ivory soap and *tepid* water; rinse only partially, rub with a dry cloth, and finish drying in the air and sun.

A less expensive variety of blanket is more practical for use in the general wards. Here, besides the purpose for which blankets are originally intended, we find them put to various uses: soaked in boiling hot water for hot packs; dampened with steam from the sweat-bath, wrapped round a patient dripping with perspiration, and so forth; add to which the nature of the cases compels us to have the ward blankets continually in the wash-tub. We all know the forlorn aspect of the average ward blanket after it has been but a few weeks in use—its diminished size, the curious frilled appearance caused by the unequal shrinking of its gay borders, the lighter weight, the harsh feeling of the wool. Except in using for their original purpose, a full-sized blanket is an unwieldly article. For the uses just enumerated old blankets, the shrunk margins cut off and bound with strips of stout muslin, are much more practical, and if provided, their use should be rigorously insisted on. Unless the old blankets are adapted in some such way, there will always be a difference of opinion as to which blanket is old and risk of a good one being spoilt. Some hospitals provide crib blankets of a light weight, made without margins for all extraneous uses—a plan that certainly contributes to the longer life of the more expensive article.

In washing, tepid water and white soap without soda

are used. After washing and rinsing, a bucket of tepid suds should be thrown over the blankets and only partially wrung out. The soap helps to keep the blanket soft and replaces, to some extent, the natural oil of the wool lost in frequent washing.

With the first hot weather all spare blankets should be put up in moth-balls, and moth-balls also laid between the fold of those left on the shelves. Where special chests or closets are not provided, the blankets, well packed with moth-balls, may be wrapped in several thicknesses of newspaper. Moths apparently dislike printers' ink, and newspaper wrappings, it is found, are never eaten through, as frequently occurs with wrappings of cotton, etc.

PATIENTS' EFFECTS

The personal effects of patients in the general wards become an item of constant trouble unless their loss is controlled by some methodical system.

Wherever possible, the clothes should be returned to the friends, since clothes that have been worn are undesirable articles to pack away in closets. Frequently, however, this is not practicable. In these cases, as soon as the patient is undressed the clothing should be gone over and the items carefully listed, the list entered in a book kept for that purpose and signed by the nurse who has taken the list. The clothing is then made into a bundle and clearly marked with the patient's name, the ward, and the date of admission. All small articles in the pocket, with the money, railway tickets, etc., should be made into a separate packet, also carefully listed, preferably in a separate book, and kept under lock and key until returned to the patient. For these articles a receipt is usually made out and given to the patient, and it should be a rule that such a packet is opened only by the patient himself or in his presence.

Should it be necessary to send any personal clothing to the hospital laundry, they must temporarily be marked with the name of the ward, otherwise, being unfamiliar to the laundry staff, they may easily be lost.

Clothing badly infested with insects is best burned. The list is still necessary, however, as the equivalent must

be given to the patient in their place. If this is impractical, they should be first fumigated with sulphur to destroy the animal life, then further disinfected, either in the autoclave or by subjection to live steam and finally washed. (See Disinfection, Chap. XII.)

SPECIAL DUTIES OF A HEAD NURSE

As a head nurse must, in her daily work, meet many conflicting interests, it is very necessary that she should arrange her various duties in as methodical a manner as possible in order to give to each the necessary time and attention.

Her first work will be to receive the report of the night nurse and, following that, to interview the day nurses and see that they understand their orders. Next in order, she should make a point of seeing and speaking to each patient under her care. However excellent a system of reporting, however well trained and disciplined the nurses actually engaged in the nursing duties may be, nothing can make up for a lack of individual interest on the part of the head nurse, and this interest must be shown if it is to be realized. It would seem a curious point to insist upon, but the writer must own that she has met not one but several head nurses who did almost all their work from the ward office. They were certainly fully informed as to all that happened in their ward, but they literally hardly ever saw a patient except when accompanying the doctors in their visiting rounds, unless some abnormal condition had been reported. One felt there was a want somewhere. Either the head nurse was overoccupied with clerical work, reports, records, and so forth, so that actually time was wanting, or she had never realized the privileges of her position.

When the domestic work for the morning is finished, a thorough round of inspection should be made daily, including closets, lavatories, milk-boxes, refrigerator, etc. The work of the ward-maid and orderlies should also receive methodical inspection.

Just how much of the actual nursing it is best for a head

nurse to do it is impossible to say on general principles; it will partly be determined by the amount of work to be done, the nature of the work, and the powers of the pupil nurses.

A head nurse is a captain, not a soldier, and while we may at times feel it easier to do a piece of work ourselves than to get as good results through a pupil, this is weak organization, and not fair to the pupil, who is there to learn her work. At the same time nothing is worse than for a head nurse to cheapen any of our various duties by taking the attitude that some are beneath her. A good head nurse should do everything, from dusting upward, just a little better than anyone else in the ward, and she should realize that her example, whether negative or positive, is bound to have its influence on her pupils.

Whenever possible, the head nurse should superintend herself the serving of the meals and ascertain whether they have been eaten and enjoyed or not. In her absence it should be the work of the senior on duty. Meals left to the junior nurses and the ward-maid, while the senior's diet duties are confined to administering the tonics, although seemingly illogical, is really not an uncommon division of duties. That it results in bad service, cold food, and a general attitude of indifference toward the meals is not an unnatural sequence. Any deterioration in the quality or cooking of the food should be methodically reported in the proper quarter.

In some hospitals one of the senior nurses is put in charge of the ward diets, her duties including ordering the supplies, distributing the food, and superintending the service of the meals. It must be remembered, however, that the nurse is only learning her work, and that training will be as necessary in this particular as in any other.

All the various details of nursing duties must, if they are to be properly done as regards the patient, and be made of full value in the nurse's training, be subject to constant inspection and comment, nor should the head nurse ever feel that her responsibilities end when she has relegated the duties to the various nurses. To the last day of her training a nurse's duties are part of her training, and it is

due to her that the best quality of work should be taught and exacted.

In going off duty for her recreation hour the head nurse will naturally choose the time in which there are likely to be least demands made upon her. Wherever possible it ought to be arranged that she can be entirely free from any calls at such times. In her absence the senior nurse takes her place, superintends the work in the wards, attends any visiting round, takes all orders, and receives any new patients that may be admitted.

THE PATIENTS' VISITORS

One weak point in the management of many wards is the attitude of the nursing staff toward the patients' friends. They forget that what is a common event to them is to these people an unusual experience, and they are naturally upset and anxious and often a little aggressively on the watch that their patient should not be defrauded of any of his rights. To treat them peremptorily, or even in a business-like, unsympathetic way, only confirms their suspicions. One can say from experience that most hospitals where good nursing standards are maintained bear investigation, and the more these methods are known, the more confidence will the public feel. At the same time this confidence cannot be taken for granted and is easily destroyed by want of a little kindly tact. Nowhere are good manners more a sheer necessity than in our relationships with the public in just these circumstances, and to err in this particular is a serious shortcoming, however sure we may be that as soon as the patient is left in our charge we shall give him the most devoted care. Let us realize that to his friends this is not a foregone conclusion.

At the risk of sermonizing, might one suggest that this is specially necessary where mothers are bringing their children to hospitals. We do not realize that probably only the pressure of bitter circumstances induces a mother of the very poor classes to leave her child in a place that she really believes to be a place of torture or, at best, of unsympathetic neglect. Why not reassure her by showing something of the genuine interest and pleasure most of

us take in our child patients? Let her realize that her child is among friends, and she will go away with one burden less on her heart. And in her weekly visits take the trouble to talk to her and gain her confidence; it is quite as easy to do as to leave her to gain a false impression if you allow her to feel she is an interloper whose visits are a trouble.

To take the other side, however, in our "visitors," especially in the general wards, we have a class little likely to appreciate the wisdom of many of our rules. Unless close watch is kept, indigestible food, unwholesome candy, and alcoholic drinks will certainly be smuggled in. It is best to allow a list of wholesome dainties, fresh eggs, fresh fruit, simple cakes, plain ice-cream, and so forth, where the patient's condition admits of such food. It is natural to dislike to visit a patient in a hospital empty handed, and the time of sickness is often the one time in the lives of our patients that they may allow themselves such simple luxuries.

In the evening the head nurse should again visit each patient before going off for the night and giving over the responsibility of the ward to her night nurse. However carefully the reports are made out, there will be some individual details about the patients to be mentioned. The verbal report between the head nurse and night nurse should always be regarded as an important part of the day's routine. Where practical it is always a good thing for the head nurse to see the night superintendent. In a large hospital, however, this is often not possible without keeping the head nurse unnecessarily long on duty.

DOMESTIC WORK

The routine care necessary for each patient has been discussed at length in the chapters on Practical Methods.

The domestic routine care will require, equally, method in its management and punctuality in the way it is carried out. A ward, where dusting is done here and there all the morning, or not at all in a rush of work; where the baths and other routine details are fitted in anywhere, is an uncomfortable one for the patients and a very tiring

one for the nursing staff. There should be an hour at which the domestic work should, as a rule, be finished, an hour for beginning the evening work, definite time, as far as possible, for all the routine details. Certain work that is not required daily should have its special day for being done.

It may be of some assistance to go over briefly some accepted methods of carrying out the domestic work of a ward.

The **sweeping** of polished floors must be done with a hair broom. After the dust has been swept up, the broom may be put in a bag of washed flannelette, or other soft material, and the floor gone over thoroughly with a regular polishing movement. For scrubbed wood floor, as well as those of stone and concrete, the ordinary corn broom is quite efficacious and more economical. Moistened bran or used tea leaves well washed in cold water may be used with advantage as dust collectors, and prevent the dust from flying about. From time to time brooms should be washed and thoroughly dried in the open air. When not in use, they should be hung or stood within, the broom end uppermost.

Mopping is not a good substitute for scrubbing, either for stone or wooden floors, but where labor is inadequate, it is frequently used as an alternative. The water must be changed frequently or the floor will show streaky black marks. Each time after use the mop should be washed in hot water with soda or soap powder and dried in the open air before being put away.

Scrubbing is the only way of really cleaning stone or woodwork. The secret of good scrubbing is hard rubbing, thorough rinsing, and frequent changing of the water. Either soft soap, a good scrubbing soap, or soap powder in very hot water serves to loosen and dissolve the dirt; if not carefully rinsed off, however, they discolor wooden floors, turning them yellow or black.

When sand can be procured, it forms an admirable and inexpensive means of cleaning wooden floors, kitchen tables, etc. A small amount of soap is necessary at the same time if the wood is really dirty. The sand is well sprinkled on the boards and then thoroughly rubbed into

the grain of the wood with a hard scrubbing-brush and hot water. Unglazed tiles, whether white or colored, should be scrubbed with a good sand-soap and plenty of clean hot water, and will require to be scrubbed daily to present a good appearance. If they get discolored and streaky from the soap, they may be gone over with dilute muriatic acid.

Two details in the interest of economy should be observed—first, the soap must not be left standing in the water; second, scrubbing-brushes and floor cloths should invariably be washed after use, well rinsed, and thoroughly dried before being put away. The bucket also should be rinsed and dried. If these details are attended to, a housemaid's closet will not present the damp, dirty, discouraging appearance so commonly seen, but will look as trim and neat as any other part of the ward equipment. Any kneeling work may cause inflammation of the bursa in front of the knee—what is known as housemaid's knee. Kneelers should, therefore, be provided with a suitable mat or an old blanket folded to several thicknesses to avert this risk.

Polishing.—Many hospitals now have polished wooden floors in the wards. They have the advantage of being less absorbent than scrubbed floors, warmer, and less tiring to the feet than any form of stone floor; the polished surface is also considered to make them less likely to harbor germs. At the same time, they require a considerable amount of time spent on them if they are to present a good appearance, since every spill, etc., spots the floor.

Many floor polishes are on the market, but none are better than a mixture of beeswax and turpentine, in the proportion of one part beeswax to two of turpentine. The beeswax is cut up in small lumps; when thoroughly dissolved, it forms a yellowish, thick fluid, about the consistence of cream. A very small amount is rubbed directly on the floor, a few yards of the surface at a time, and polished *until perfectly dry* with a special weighted brush with a long handle. The brush is weighted with lead, and weighs about thirty pounds. It is wrapped in a piece of thick soft flannel or blanket. If the floor is left sticky, it will

catch the dirt and dust. Any such accumulations must be removed with turpentine before repolishing the floor.

In many hospitals floors are colored, varnished, or shellacked previous to polishing. This is labor-saving in the beginning, but costly, since if accidents occur which remove the polish,—and they are almost unavoidable,—there is either an unsightly patch, or the whole floor must be scraped and repolished. Where nothing but the beeswax and turpentine mixture is used, any patch can be quickly rubbed up to look like the rest of the floor.

The weighted polisher must be used daily, and, as a rule, once a week is sufficient for a fresh coating of polish.

Only hardwood floors, oak, teak, maple, etc., are capable of taking a good polish. If desired, when first laid, the boards may be darkened with linseed oil before polishing. At first, when beeswax and turpentine alone are used, a considerable amount of labor is necessary before the polished boards present a good appearance; once well polished, however, they are easily kept at comparatively small cost.

In the weekly polishing two should work together—one kneeling to apply the polish, and the other using the polisher. With a little practice the polisher can be used without much exertion, since the handle is on a hinge and the weighted brush can be pushed backward and forward with a swinging movement not difficult to acquire. Floors covered with cork carpet, linoleum, etc., may either be scrubbed or polished in the same way.

Dusting is usually the first of the domestic duties assigned to the nurses. After sweeping, a short time should elapse to allow any dust that has been raised to settle before the dusting is begun. The dusters should be dampened with clean water, in order that the dust may more readily adhere. The use of a disinfectant is an unnecessary expense, since it cannot be used in sufficient strength to do any practical good. For polished surfaces, dry, soft dusters should be used.

Dusting must be taught, so slovenly and inadequate are the average ideas on the subject. Every corner of the ward, including any ledges above the level of the head

and the top of the skirting boards, should be thoroughly gone over daily. At the present day ward furniture is especially contrived so that it can be readily cleaned, a large part of it being white enamel ironware and glass, so that there is no excuse for anything less than spotless cleanliness. It is an excellent rule that each nurse should wash out her own duster in hot soap and water daily, immediately after use.

Enamel Ironware.—Finger-marks and most stains are easily removed by washing in soap and water. Soaps containing pumice or sand (Sapolio) should not be used, as they scratch the polished surface and loosen the enamel. Acids and strong disinfectants also destroy the polished surface. Intractable stains are best removed with Labarraque's solution. The only disadvantage of enameled iron is the readiness with which it is chipped—a tendency that is apparently increased if subjected to high temperature, as in the autoclave. Enameled iron is the popular ware for kitchenware and lavatory utensils, and is largely used for bath-tubs and sinks.

Glass.—Soap and hot water are quite sufficient to clean glass, and the use of expensive drugs, such as ammonia, alcohol, liquor potassæ, etc., to save labor, is an extravagant habit that should never be countenanced. Ammonia in time will destroy the polished surface of glass. Cheese-cloth or flannelette rags or a soft chamois-skin should be used to rub up the surface after washing. Where glassware has become badly soiled and scrubbing in soap and water fails to remove the stains, a paste of whiting moistened with water, or, if the stains are very bad, with a little ammonia, may be used.

Marble becomes discolored with ordinary soaps and stained with grease and many of the commonly used disinfectants.

To clean marble a paste of whiting and ammonia may be made, spread over the surface, and left overnight; in the morning it should be rubbed away with a dry cloth. The process is repeated until the marble is clean.

The polish of marble is destroyed by acids, a great disadvantage where, in the form of terrazzo, it is used for

the flooring of operating-rooms and out-patient departments. If any acid is spilled, it should immediately be neutralized with an alkali, such as aqua ammonia, washing-soda, etc.

The **porcelain** and enameled iron used for bath-tubs, basins, and sinks is frequently wantonly destroyed by strong alkalis or acids, or even by the use of soaps containing pumice or sand or strong alkalis. The smooth surfaces become roughened, unsightly, and difficult to clean. If it is necessary to soak any article in a strong alkali or acid, a zinc bucket or unpainted wooden tub should be used. In cleaning tubs, etc., grease stains that have been allowed to dry are difficult to remove with ordinary soap-and-water washing. A cloth moistened with very little turpentine or coal-oil may be permitted. Stains from bichlorid of mercury, permanganate of potash, etc., will generally yield to Labarraque's solution. Rust-marks, or marks from dripping of hard or impure water, are difficult to remove, and may require an application of one of the patent soap powders, Porcella, or Bon-ami. These are, however, proportionally high priced, and should be used only when " elbow grease " and good scrubbing or an application of Labarraque's solution have failed.

Stains in lavatory sinks and water-closets should be treated by prevention. They do not occur if the basins are well brushed down every day, and always well rinsed after use. Labarraque's solution, or Bon-ami, or Porcella will usually remove all such marks.

Iodin stains may usually be removed by a paste of starch and alcohol, which should be applied at once.

Polished Furniture.—In the private room of a hospital tables and bureau of highly polished woods are often met with. Like all furniture in constant use, they are liable to become dirty.

Greasy stains, etc., may be removed by washing with a soft cloth in warm (*not hot*) soapsuds. The surface should be dried and rubbed up with soft, dry cloths. If the polish is dimmed, a very little furniture polish may be rubbed on with a flannel and rubbed up until bright. A polish of equal parts of sweet oil, turpentine, and

alcohol is serviceable and less expensive than patent polishes.

White marks on polished surfaces are removed by rubbing quickly with a flannel soaked with a small quantity of camphor or soap liniment. Another method is to place a sponge wrung out of boiling hot water exactly on the spot; repeat the treatment until the spot is effaced, and then rub up with furniture polish.

If the surface has been entirely lost, as by carelessly placing very hot articles (such as a can of hot water) directly on the polished wood, it is generally necessary to send the furniture to a dealer to be repolished. Olive oil applied with very small absorbent cotton pledgets and lightly rubbed into the wood may restore the polish, but the process is tedious and really requires expert practice. Experience shows it is necessary to teach nurses not to place hot articles on polished wood.

Alcohol spilled on polished wood will also remove the polish. Olive or cottonseed oil should be poured immediately over alcohol accidentally spilled, to neutralize the effect.

Stains on Scrubbed Wood.—*Bad grease stains* are very difficult to remove entirely. An acid—oxalic acid or hydrochloric acid—may be used to cut the grease, following which the stain should be well scrubbed with cold water and ammonia and sand or a sand-soap.

Ink, if spilled, should be sopped up with flour at once, and may then be treated in the same way with an acid, followed by ammonia and sand-soap. Small spots may be covered with common salt and rubbed until they disappear with a squeezed lemon.

Blood-stains on absorbent surfaces are apt to leave discolored marks. They should be washed in *cold* water before they become dry, in order, as far as possible, to dissolve the albumin. Small spots on wood (as on linen, etc.) may be completely removed with peroxid of hydrogen, but this is, obviously, a costly method.

Iodin should be treated with a paste of starch and ammonia or alcohol, left on for some time, and washed off with ammonia and water and finally thoroughly rinsed.

Cleaning of Brass, Copper, and Other Metals.—Labor can be materially saved by having metal work coated with lacquer, a process carried out by furniture-dealers. This is usually done for brass bedsteads and vessels, etc., not in constant use, but is unsuitable otherwise, as washing or exposure to heat destroys the lacquer. The usual metal polishes also destroy lacquer, and nurses and ward-maids may require to be reminded not to polish lacquered metals.

One or other of the patent pastes and fluids on the market for polishing brass, copper, and zinc are commonly used in hospital work. As they are expensive, they must not be used extravagantly. When the article can be first washed in hot soda and water, a smaller quantity of the polish will be necessary. If metal work is polished daily, it takes but little time to make it bright or clean.

Brass or copper that has become very dirty is best cleaned with a strong solution of oxalic acid, which should be removed with a little coal-oil.

The coal-oil is used to arrest the action of the oxalic acid, which, if continued, would destroy the metal, and helps to give the article a brighter polish.

White metals, silver, nickel, or pewter, are most economically cleaned with a paste of whiting and water, or, if very dirty, of whiting moistened with ammonia.

The secret of well-kept brights, however, lies chiefly in clean, dry polishing rags and thorough rubbing.

Saucepans and Kitchen Crockery.—Saucepans, tea-kettles, and such homely articles in enamelware are short-lived, indeed, unless a special point is made of their care.

Milk, gruels, cocoa, and foods of like nature, which readily burn, should invariably be cooked in double boilers. The saucepan is then easily cleaned with hot water and a little soda, whereas if burned, the violent rubbing and use of Sapolio and such soaps are apt to chip the enamel and make further burning inevitable. If burning has taken place, and the marks do not readily come away, they can generally be removed with a little salt just moistened and rubbed on the spot with the tips of the fingers. If this is not sufficient, an application of Labarraque's solution will usually be effectual.

A kettle will last forever if not put on the stove empty. Nurses should be trained invariably to replace whatever water they take from a kettle.

Each saucepan should be cleaned immediately by the nurse who has used it, and the inspection of the saucepans should be a routine part of the daily round.

The Ice-chest.—The shelves of an ice-chest should be removed daily, and the whole interior wiped with a clean, damp cloth. Any spills must be removed at once. Once a week the whole chest should be well scrubbed with strong soda water and thoroughly dried. The drain-pipe must be flushed at the same time with boiling hot soda water, to prevent it becoming clogged. Milk, butter, and eggs should not be kept in the same compartment as other foods. Milk and butter absorb odors, and pure air at a low temperature is essential to keep eggs fresh. If there is only one ice-chest, these articles must be closely covered.

Sinks and Hoppers.—To keep sinks and hoppers free of grease, boiling soda water should be poured down the soil-pipe twice a week. A fine wire-basket strainer kept in each sink prevents the too frequent blocking of the soil-pipe by lost articles, fluff from the mops, etc.

A not infrequent accident with taps and spigots is the sudden giving way of a neglected washer, followed by a flood of water that cannot be checked. Every nurse should know the points at which the water-supply in her department can be temporarily cut off.

The Walls.—Except, perhaps, in perfect mechanical ventilation, the walls of a ward quickly become covered with dust, which, if undisturbed, is not long in collecting cobwebs. The condition is minimized by the use of highly varnished, painted, or tiled surfaces, but to some extent dust on the walls is inevitable. As dust in a ward forms a resting-place for germs, it is necessary that the dust should be removed.

Each week the walls should be swept down with a soft broom tied in a bag of cheese-cloth or flannelette. At longer intervals the walls may be washed, using a large sea-sponge or soft rags and plenty of clean tepid water. Bad stains, such as over the radiators, may require a little

soap. The polished surfaces must be well dried and rubbed with soft, dry cloths to prevent smearing.

Greasy marks from fingers, heads, etc., on highly varnished paint are best removed by rubbing with stale bread.

Beds and Bedding.—At the present day the enameled iron bedstead has practically replaced all other kinds for hospital use. Fitted with a chain or wire mattress, it is comfortable, easy to clean and handle, and with care in preventing chipping of the enamel, wears well. It has one great advantage over the old wooden or painted iron bedsteads, that it does not harbor bedbugs.

After each patient goes out, the enamel part of the bedstead should be washed in warm water and soap. Stains may be removed by the processes already described for other enameled ironware. The use of a disinfectant is no material advantage, since it cannot remain sufficiently long in contact with the iron to be in any sense an active agent.

The mattress is one of the most abused of articles in hospital equipment. Wherever necessary, the mattress should be protected by a heavy rubber sheet under the linen one, covering the entire mattress. This rubber should constantly be inspected, as if cracked or worn, it is no longer waterproof, and no longer of any use. A slip-cover of unbleached cotton, which can be changed and washed, should always be used to keep the mattress clean.

Patients with chronic incontinence are frequently nursed on mattresses filled with straw or dried grass, or the mattress is dispensed with and replaced with old soft blankets covered with a rubber sheet, which can be washed when necessary.

After a patient's discharge, the mattress should be taken in the open air, thoroughly brushed with a hard whisk, and left in the sun for about six hours. Before being used again it should be carefully examined and sent at once to the repair room if there is the smallest tear.

Disinfection can properly be done only by exposure to high temperature, as in an autoclave. Where this is not available, exposure to the fumes of formalin is considered suitable for most cases. This is not usually considered

sufficient if the case has been one where the infection is spread by the fomites, as in smallpox or scarlet fever.

Stains are difficult to remove, as rinsing in water will injure the hair or flock with which the mattress is stuffed. Blood-stains can be removed with peroxid of hydrogen. Other stains may yield to washing with ammonia and water; the part washed should be rubbed as dry as possible and instantly exposed to sun and air until quite dry. Mattresses may become infested with bedbugs. To kill these nothing is so efficacious as the fumes of sulphur. (See Disinfection.) Sulphur, however, will not destroy the eggs; in bad cases the mattress may have to be destroyed; in milder cases, the hair may be cleaned at an upholsterer's and sewn into fresh ticking.

Pillows, either of hair or feathers, should be, where necessary, protected from soiling or wetting (as from an ice-bag) by slip-cases of rubber. These should not be retained unnecessarily, as they are heating to the head. If the ticking becomes stained, it is best to remove the stuffing and have the soiled ticking washed in the laundry.

Surgical Supplies.—The care of rubber goods, instruments, and special surgical appliances is discussed in Chap. XIII.

VENTILATION AND TEMPERATURE

The necessity for a constant supply of fresh air and its special importance in the hospital ward or sick-room cannot be too constantly enforced. It is a point that should never be lost sight of, and will require, unless the building is mechanically ventilated, constant personal attention. All sources of impurity, bed-pans, soiled dressings, etc., should be quickly removed from the ward; if any odor is perceptible, the adjacent window should be opened for a short time.

Garbage-cans and dressing-cans are a source of impurity unless kept closely covered and emptied and thoroughly cleaned at least once a day. The galvanized iron cans with closely fitting covers commonly used are the most sanitary available.

The temperature of the ward is another subject re-

quiring constant vigilance. Wards and sick-rooms should be kept as nearly as possible at an equal temperature, with little variation in the twenty-four hours. The self-registering thermometer is the most accurate means of ascertaining the variations of temperature. Where the ordinary wall thermometer is used, the temperature of the ward should be recorded every four hours. The record may be kept in the form of a chart, like a clinical chart, or noted in a small copy-book conveniently ruled for the purpose. The chart or record book must be inspected daily by the head nurse, and from time to time checked by her, to insure its accuracy.

THE VISITING ROUNDS

One of the important duties of a head nurse is to accompany the visiting doctors or the residents on their rounds. She must make a point of being fully informed as to every detail concerning her patients. Few things are more trying than the head nurse who either discovers or "remembers" facts after the visit is over. In the usual etiquette of the round of the visiting chief, he obtains his information concerning the patients from the resident, and the head nurse is required to report only if directly asked. If there should be some information to report which she has not yet been able to communicate to the resident, she should make an opportunity of telling him privately of the facts, so that he may include them in his report.

All record charts, report books, and the day-book should be readily available, and the convalescent patients each seated by his own bed. Obviously, talking or noise of any sort is out of place during a round. One nurse (either the senior or, preferably, the nurse in charge of the cases) should accompany the head nurse, her first duty being to arrange the patients for examination and to settle them comfortably afterward.

The other nurses should continue their work quietly; it is usually considered etiquette, however, that they should not be seated during the round unless with permission.

In a surgical ward dressings should be placed in readiness by any case that the surgeon may be expected to look

at, unless, as is now happily often the case, dressings are done in a room especially reserved for the purpose, and not in the ward. Lotions and water should be already heated, and the instruments sterilized, and placed ready for use in a sterile towel. By such forethought a great deal of time may be saved.

In a medical ward a large square of flannelette or some thin, soft material should be at hand for each patient when the chest is examined. Failing this, an ordinary towel may be substituted.

To the nurse is intrusted the care of the patients' comfort during the round. It should not be left to the doctor to suggest closing a window during a dressing or examination, or placing a screen to obtain privacy. For all examinations and dressings, however slight, a screen should be placed round the bed. This is both in the interest of the individual patient and for the sake of his fellows in the ward, to most of whom the sight of a dressing is naturally repulsive. This, however, is a point on which both nurses and doctors are apt to become careless, and it is for the head nurse to see that the screens are used when necessary.

In touching on the above points of ward management and the duties and responsibilities of a head nurse, the subject is obviously far from exhausted. Even the construction of the hospital may alter many details and entail an arrangement of duties, etc., different to those suggested. The fundamental fact, however, of the gravity of the responsibilities of each head nurse, and the immense importance of her influence on others, whether for good or ill, will be the same under whatever conditions she undertakes her work.

APPENDIX

RECIPES

Except where the recipes have been taken from private sources, the quantities, time, etc., are those recommended by Miss Farmer, in her book on invalid cooking, all of which have been frequently tested.

MILK

Milk is pasteurized by being kept at a temperature of 155° to 167° F. (66°–75° C.) for thirty minutes.

A double boiler must be used, to lessen the risk of the temperature rising too high or of the milk scorching.

In pasteurizing milk for infants' food, the amount for the twenty-four hours is divided, and each feeding placed in a freshly sterilized nursing-bottle. The bottles are arranged most conveniently in a bottle-rack, and are placed together in a boiler or kettle of suitable size, filled with sufficient cold water to rise halfway up the bottles. When a rack is not used, the bottles should stand on a folded towel or a tray, raised a little from the bottom of the kettle. After exposure to the required temperature for half an hour, the bottles are rapidly cooled and placed on ice until required. To warm the feedings, the bottle is placed in a basin of hot water.

To cool quickly, without breaking the bottles, remove them from the kettle and place in a pan of warm water, set the pan under the water-tap and let it run over the bottles first warm, and, as the bottles cool cooler, until the water in the pan is quite cold; then place the bottle at once on ice.

There are many patent pasteurizers on the market, by the use of which the process may be carried out with greater exactitude.

Where the process has to be entrusted to the mothers in poor homes, the following method is simple and reliable:

Fill a soup kettle half full of boiling water; place the bottles, with the feedings measured, in the kettle; cover closely and set in a moderately warm place (an average room-temperature) on a *wooden* table for half an hour; remove, cool the bottles quickly, and place in the coldest place available, on ice if possible, or in a pan of cold water. Wood being a non-conductor, helps to maintain the water at an even temperature.

To Sterilize Milk.—The milk is kept at a temperature of 212° F. (100° C.), *i. e.*, at boiling-point, for thirty minutes, otherwise the process is the same as in pasteurizing. The scum which forms on the milk is of high nutritive value and should be reincorporated by beating with an egg whisk.

If lime-water is used with either pasteurized or sterilized milk in making up infants' food, it must be added after the process is com-

plete. The action of lime-water on sugar at a high temperature converts the sugar into caramel, giving the mixture too sweet a taste and a brown, uninviting appearance.

To Peptonize Milk.—Various preparations are in use for the *peptonizing* or *predigestion* of milk, each of which is accompanied by full directions for their use.

Fairchild's peptonizing powders (extract of pancreas, 5 grains; bicarbonate of soda, 15 grains) are one of the most convenient methods, and are generally used in hospital work.

Dissolve one powder in 4 ounces of cold water. Add, when dissolved, to 12 ounces of fresh milk. Set in a pan of water at a temperature of 105° F. (25° C.), and keep at that temperature for fifteen minutes.

In order to arrest the further process of predigestion, the mixture is then either brought quickly to boiling-point or immediately cooked (as described) and placed on ice until required.

Fully peptonized milk is extremely bitter, and is practically used only for rectal feeding or gavage.

In peptonizing infants' food, dissolve the powder in 4 ounces of water, and use half an ounce of the peptonizing fluid to every two ounces of the feeding.

Koumiss.—Two or three methods, the following recommended by Miss Farmer:

1 quart milk.	¼ yeast cake.
1½ tablespoons sugar.	1 tablespoon lukewarm water.

Heat the milk to 75° F. (24° C.), add sugar and yeast cake dissolved in warm water. Fill sterilized bottles to within one and a half inches of the top, cork tightly, wiring, if necessary, and shake.

Place the bottles, upside down, in a temperature of about 70° F. (21° C.) for ten hours.

Keep for forty-eight hours in a cold place, shaking well from time to time.

Clabber, or Milk-jelly.—Set one quart of milk in a covered bowl on the back of the kitchen stove until the milk begins to turn; remove to a moderately warm place, such as a wooden shelf in the kitchen, until firmly set, which will take from twelve to twenty-four hours. Serve with cream and sugar if desired. Clabber, like koumiss, is usually found easy of digestion and is generally retained.

Milk-curds, or Junket.—To one pint of sweet milk, at a temperature of about 100° F. (43.3° C.), add two teaspoons of liquid rennet or one-quarter of a junket tablet, dissolved in a little cold water. Stand on a wooden shelf in a moderately warm place until set, then place on ice. Sprinkle with powdered cinnamon, and serve with cream and sugar.

Whey.—To extract all the whey from junket, proceed as described. When the curd is well set, break it up thoroughly with a silver fork and strain through cheese-cloth. One quart of milk yields about a pint and a half of whey.

Whey is frequently used in infant-feeding, combined with cream, or used instead of water in a modified milk formula. Before mixing with cream or milk, the whey and the milk mixture must be heated separately to a temperature of 150° F. (71° C.), and then mixed, otherwise the fermentative action of the rennin will curdle the fresh cream or milk.

White Wine Whey.—As above, one gill of sherry to a pint of

milk in place of rennet. Strain and serve hot, with a little sugar if preferred.

Milk-punch.—Warm half a pint of milk, with a small pinch of salt and sugar to taste; add one tablespoon of whisky, brandy, or rum.

Buttermilk.—Strain the fluid left after making butter into a sterile vessel. Keep on ice until required.

EGGS

The albumin of white of egg is soluble in cold water and coagulates in water at a temperature of 134° F. (56.4° C.). If it is exposed to a high temperature, it becomes tough, leathery, and less easy of digestion. In cooking eggs for the sick-room care should be exercised on this point, and eggs should be cooked slowly, at a moderate temperature.

A soft-boiled egg is the most easily digested form in which eggs can be offered. The white should be creamy and the yolk about the consistency of jelly. To get this result the water in which it is cooked should not be above 175° F.

Soft-boiled Eggs.—Place in a covered vessel in hot water (about 175° F.) sufficient to cover the eggs, and stand where the temperature will not be rapidly cooled from seven to ten minutes. Where many eggs are cooked together, the water should be of a higher temperature to start with (185° F.), as the eggs will cool it considerably. The eggs should be tied loosely in a net, so that they may all be placed in the water and taken out at the same time.

Hard-boiled eggs are indigestible unless cooked sufficiently long that when removed from the shell the yolk is easily powdered. In this condition they are as easily digested as when soft boiled. They should be placed in water at about 175° F. and kept at that temperature for forty-five minutes.

A hard-boiled egg may be chopped finely, mixed with a little butter, seasoned with pepper and salt, and served as a sandwich with thin bread and butter. Chopped parsley or anchovy paste may be added as relishes.

Scrambled Egg.—Break one egg in a bowl, and with a spoon stir in a tablespoonful of milk and a pinch of salt. Melt half a tablespoonful of butter in a small frying-pan, add the mixture, holding the pan well above the flame, so that it cooks slowly. When it begins to set, break up with a fork and serve hot on a piece of crisp toast. Where permissible, the toast may be spread with a savory paste, such as anchovy.

Poached Egg.—Slip an egg out of the shell into a cup or large spoon lightly greased with a little butter, place it in a saucepan with hot water (about 175° F.) sufficiently deep to cover the egg; cook until the white is set. Season with salt and pepper and serve on a small piece of buttered toast and garnish with a sprig of parsley.

Coddled Egg.—Break an egg in a cup with a spoon, add 5 ounces of hot milk (about 165° F.), cook in a double saucepan, stirring constantly. Season with salt and pepper and serve on a piece of toast.

Shirred Egg.—Use an egg-shirrer or a small custard cup. Mix a spoonful of crumbs with a little butter; grease the cup lightly with butter and sprinkle with bread-crumbs; slip the egg into the cup, add a sprinkling of salt, and cover with the remaining crumbs. Bake in a

moderate oven until the white is set; garnish with a sprig of parsley, and serve in the cup in which it is cooked.

Albumin-water.—The white is the most easily digested portion of the egg; being soluble in cold water, it may frequently be given in beverages.

Break the albumin up by stirring with a spoon; add slowly, while still stirring, half a pint of cold water and a small pinch of salt.

If desired, the albumin-water may be flavored with a little fruit syrup or the juice of fresh fruit. Egg-albumen may also be given in sweet milk or in whey, instead of in water.

Wine and Egg-albumen.—Beat the white of one egg stiff with a knife, adding gradually about two teaspoons of powdered sugar; add, still beating, a wineglass of sherry, port, claret, or other still wine; serve in wide wineglass on crushed ice with a spoon.

Meringues.—Beat the whites of two eggs until stiff with a knife, and fold in half an ounce of powdered sugar; drop from a teaspoon in small heaps on to a wet board; bake in a quick oven until lightly colored. Served with cream, either plain or ice-cream, they form a tempting desert in a restricted diet.

Eggnog.—Beat one egg, adding gradually half a tablespoon of powdered sugar, a pinch of salt, and one tablespoon of brandy or three of sherry; when well mixed, add ice-cold milk to eight ounces.

If preferred, the white may be beaten separately until stiff, and added on the top of the glass containing the eggnog.

Eggnog with Coffee, Tea, or Cocoa.—Break the egg with a spoon, adding sugar and a pinch of salt. Stir into a little cold milk, and add to a cup of coffee, tea, or cocoa.

GRUELS

Oatmeal Gruel.—Into a pint of boiling water run through the fingers two heaped tablespoons of oatmeal and a pinch of salt, stirring all the time; allow to boil briskly for two minutes, then cook slowly in a double saucepan for one hour, stirring from time to time; strain, thin to required consistence with hot (not boiled) milk, and serve very hot. Cream may be added when desirable.

Barley Gruel.—Make one tablespoon of barley flour into a paste with a little cold water; add to one pint of boiling water while stirring, and boil fifteen minutes; strain, add hot milk, allow to reheat together and serve hot.

Arrow-root.—Dissolve two teaspoons of arrow-root in a little cold water, place in a double saucepan, and add half a pint of hot milk and a pinch of salt; stir over the fire until it thickens; then allow to cook slowly for ten minutes; serve hot with sugar to taste; sprinkle, if desired, with a little nutmeg or cinnamon.

Cracker-gruel.—Crush a couple of plain crackers into crumbs and bake in a slow oven until quite brown, in order to dextrinize the starch; add to half a pint of hot milk with a pinch of salt, and cook in a double saucepan about five minutes.

Rice-gruel.—Wash one tablespoon of rice and stand for about two hours in cold water; pour off water; add rice to cold milk, and cook in a double saucepan for an hour and a half; strain, add salt, and serve either hot or cold.

Rice-flour Gruel.—Make one tablespoon rice flour into a paste with a little cold water and add to a pint of hot milk with a pinch

of salt. Cook in a double saucepan for fifteen minutes. Add sugar to taste, and flavor, if desired, with cinnamon or nutmeg.

Apple-gruel.—Pare, core, and cut up a large apple; cover with one pint of boiling water, and simmer slowly until reduced to a pulp; then strain. Mix one tablespoon of arrow-root with cold water, and stir into the hot apple water until it boils. Boil two minutes, then cook slowly in a double saucepan for three minutes; flavor, if desired, with a little lemon-juice. Sugar should be used sparingly.

Flour-gruel (Pap).—Make two tablespoons of flour or corn-starch into a paste with cold water and add to a pint of hot milk. Add a pinch of salt and cook for twenty minutes in a double saucepan. Add sugar to taste, and flavor with nutmeg or cinnamon, if desired.

In making the above gruel and other farinaceous foods patent starch preparations are frequently used instead of the raw articles, and require less time for cooking, as the starch is already partially dextrinized. Directions for their use accompany each package. Robinson's patent foods are always reliable.

Oatmeal Jelly.—Set two ounces of oatmeal in one quart of cold water and allow to soak about twelve hours; bring to the boil, and cook slowly down to one pint; strain while hot, and leave in a cold place to set.

Barley Jelly.—Wash one ounce of pearl barley in cold water until clean; add to one quart of cold water, and boil slowly down to one pint; strain while hot, and leave in a cold place to set.

Dextrinized Flour With Buttermilk (For Infant-feeding).—Wheat flour, 4 ounces (by measure); cold water, one pint. Mix the flour to a smooth paste in a little of the water; put the remainder on the fire in a double saucepan. When boiling, stir in the flour and allow to boil twenty-five minutes, stirring occasionally to keep smooth.

Take from fire; cool down to between 140° and 160° F. Then add two teaspoons of "Cereo" (a patent preparation); stir for ten minutes, keeping the mixture at an even temperature. To each ounce of the mixture add half an ounce of cane-sugar, stirring until dissolved. Strain through cheese cloth and put on ice.

Add to fresh buttermilk just before feeding, in the proportion of half a dram of Cereo-sugar mixture to each ounce of buttermilk.

Dextrinized Barley-gruel (For Infant-feeding).—Barley flour, one heaping tablespoon; boiling water, one pint. Mix the flour to a paste with cold water; add to the boiling water, and boil for fifteen minutes, stirring occasionally. Cool as above, and add Cereo as in flour mixture. Add two ounces of cane-sugar to one pint of gruel. Strain, and keep on ice. Give with whey in the proportion of two parts gruel to one of whey. The two last recipes (from the Philadelphia Children's Hospital dietary) are valuable substitutes for milk in cases of protein indigestion.

MEAT-TEAS, ETC.

Beef-juice.—From half a pound of lean, tender steak remove all fat. Broil on both sides over a hot fire for four minutes, turning quickly at first to seal the juices. Cut into small pieces, and squeeze through a lemon-squeezer or meat-press into a warm cup. Stand the cup in water about 130° F. until the juice is warmed through, but not cooked, and season with salt. Serve at once. If to be kept,

the juice is seasoned with salt and placed on ice, but not reheated until required. It may also be taken iced, or added to milk if desired.

Beef-tea.—From one pound of lean, tender steak from the round remove all fat and cut up in small pieces; place in jar, add one pint of cold water, and cover closely. Stand the jar in a kettle of cold water also covered. The water in the kettle should be sufficient completely to surround the contents of the jar; unless a double boiler is used, the jar should be raised from the bottom of the kettle on an inverted saucer, etc. Bring the water in the kettle slowly to a temperature of 130° F., and keep about that temperature for two hours; then raise to 170° F. until the beef-tea becomes brown, in order to remove the unpleasant raw taste. Remove the meat and season with salt.

In warming before serving care must be taken not to boil any meat preparation.

Chicken-tea.—Use a whole spring chicken; clean, disjoint, and remove the skin and fat. Put in a kettle of cold water, one pint to each pound, and bring slowly to boiling-point. Add salt and pepper and cook slowly until the meat is tender, skimming, when necessary. Strain and remove the fat. Serve with a little well-boiled rice and chopped parsley, heated with the broth; or, if preferred, with a beaten egg or thick cream, in the proportion of one egg or one tablespoon of cream to half a pint of broth.

Mutton-broth.—Take three pounds of lamb or tender mutton from the forequarter; remove skin and fat, and cut up in small pieces; put in a kettle with three pints of cold water. Bring gradually to boiling-point; add salt, and cook slowly until meat is tender, skimming when necessary. Strain and remove fat.

Serve with a little well-boiled rice or barley and chopped parsley.

BEVERAGES

Lemonade.—Squeeze the juice of one or two lemons with a lemon-squeezer; add powdered sugar to taste, and dilute with iced water, either plain or carbonated; serve with a slice of lemon or a cherry or whole strawberry. Drink through straw.

Lemonade may also be made with hot water in the same way, and taken hot. In this way it induces sweating and is serviceable for breaking up colds, etc. The juice of oranges or the strained juice of crushed fresh strawberries, grapes, or currants may be used in the same way.

Where a high caloric diet is being used, milk-sugar may be used in place of cane-sugar. In this case the milk-sugar is dissolved in a little cold water and boiled for two minutes (p. 799); the amount of the sugar solution added depends on the quantity of milk-sugar to which the patient has become accustomed.

Imperial Drink.—To each pint of lemonade, made as above, add one heaped teaspoon of cream of tartar; stir until dissolved. Useful in conditions of deficient elimination, especially when the kidneys are affected, and may be taken freely.

Barley-water.—Wash two tablespoons of pearl barley in cold water; place in half a pint of cold water, and bring to the boil; throw the water away, add two pints of cold water, bring to the boil, and allow to simmer gently until reduced to one pint; strain, and serve ice cold with a little lemon-juice and sugar. Barley-water

unflavored is frequently ordered in the place of water to dilute the milk for the infant-feedings, or as a substitute for milk in cases of intestinal irritation.

Rice-water may be made in the same way, and is also useful in cases of intestinal irritation. In these conditions beverages are usually ordered cold.

Oatmeal water is also made in the same way (oatmeal, half an ounce, to one quart of water), and is ordered chiefly for rectal irrigation in certain irritated conditions of the intestines.

Rice-milk.—Wash two tablespoons of rice in cold water and soak in one pint of cold water half an hour; bring gradually to boiling-point and cook slowly until the rice is soft; strain and dilute with hot milk or cream; season with salt or sweeten with sugar, as preferred.

Flaxseed-tea (Linseed-tea).—Wash one ounce of whole flaxseed and pour over it one quart of boiling water; simmer to half the quantity; strain and add the juice of one lemon and sugar to taste.

Frequently ordered in inflammatory conditions of the kidney. As a soothing drink and mild expectorant in bronchial affections it is often ordered with the addition of a small quantity of licorice root (about two drams), cooked with the flaxseed.

Without flavoring, flaxseed tea is also used as a rectal irrigation.

Toast-water.—Toast two slices of bread crust and crumb to a dark brown; place in a deep dish and pour over it one quart of boiling water; cool and when cold, strain.

Serve cold; flavor if desired with lemon-juice or serve with a slice of lemon. Toast-water is often effectual in relieving nausea.

Ginger-tea.—Mix half a teaspoon of ginger in a tablespoonful of molasses, add a cup of boiling water, and allow to boil one minute.

If preferred, half the quantity of water may be used and the amount made up with hot milk. Useful as a carminative in dyspeptic flatulence and to relieve abdominal cramps.

Cocoa or Baker's Powdered Chocolate.—Mix a teaspoon of cocoa into a paste with a little cold water, add half a cup of boiling water, sufficient sugar to taste, and a very small pinch of salt; boil for one minute, stirring constantly; add, while still stirring, half a cup of scalded milk, and pour into a heated cup.

A larger proportion of milk may be used if preferred, or a spoonful of whipped cream can be added.

A few drops of essence of vanilla placed in the cup before the cocoa or chocolate is poured will give additional flavor.

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